GAS JOURNAL

LIGHT . HEAT . POWER . BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

Vol. 203. 85th Year. LONDON, SEPTEMBER 6, 1933. No. 3668. Price 1s.

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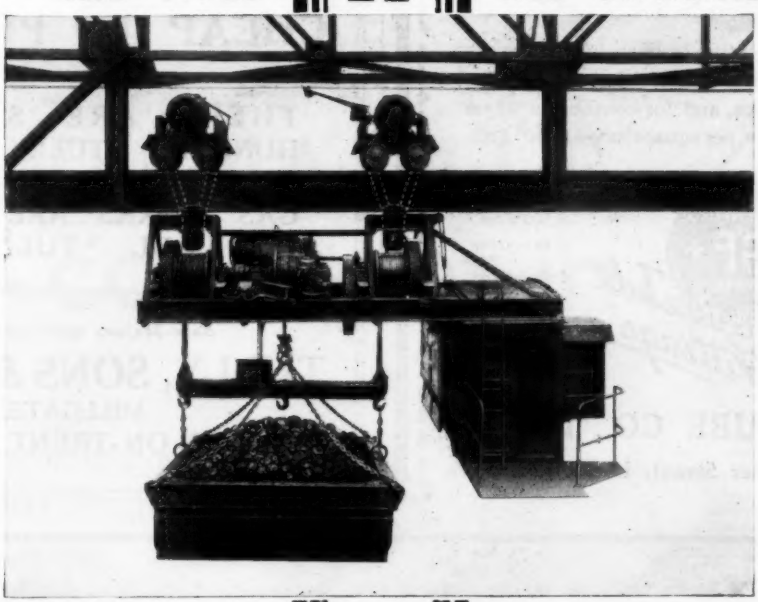

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For handling Coal, Coke, Oxide, etc., by means of Skips or Grabs.

The illustration shows a 7-Ton Gross Load, three barrel machine for handling coke from Intermittent Vertical Retorts.

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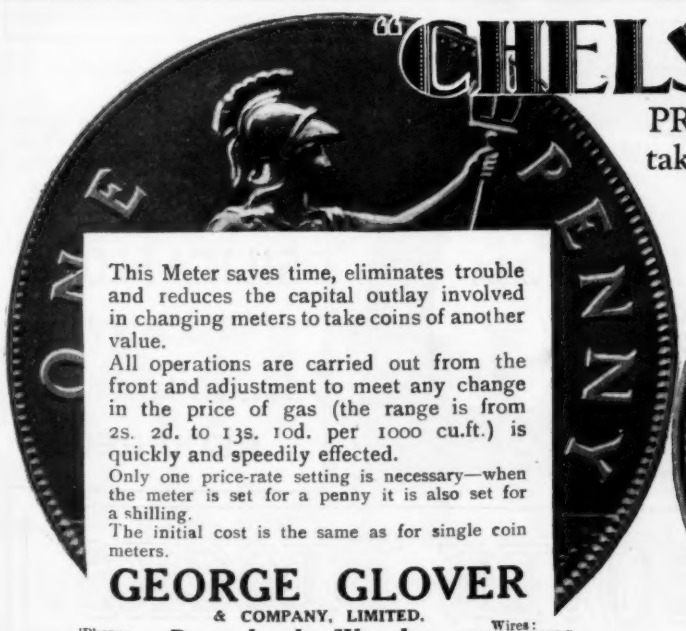

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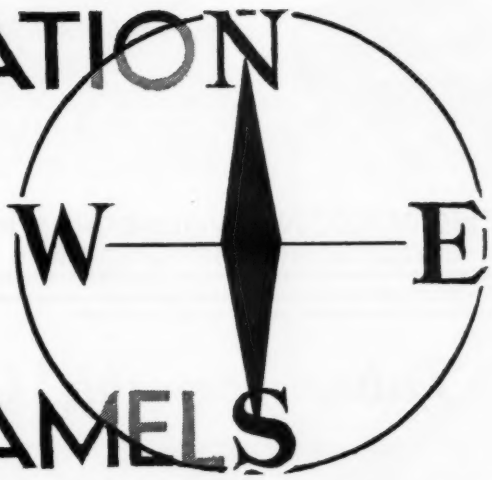

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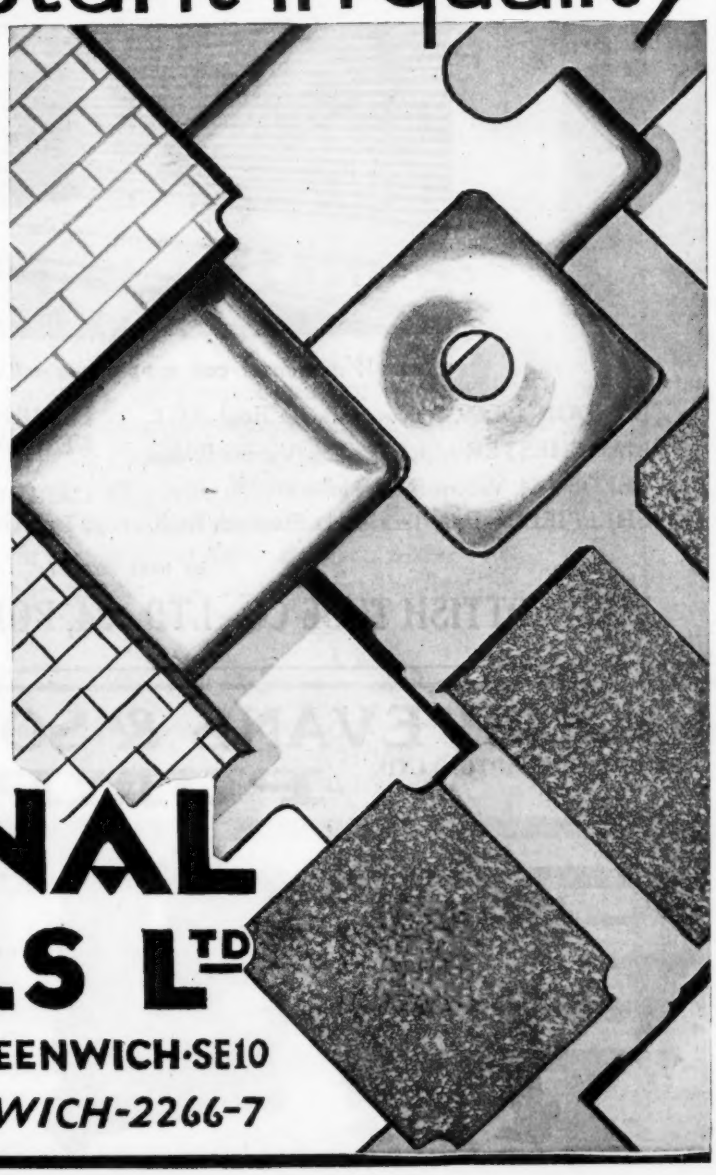

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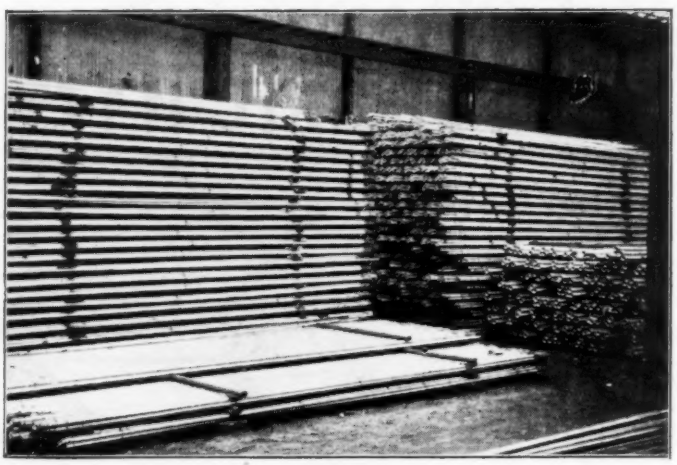

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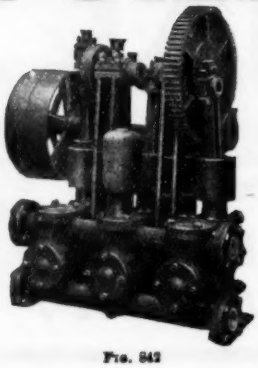

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Fig. 105 Fig. 266 Fig. 267 Fig. 842 Fig. 187 Fig. 69 Fig. 354

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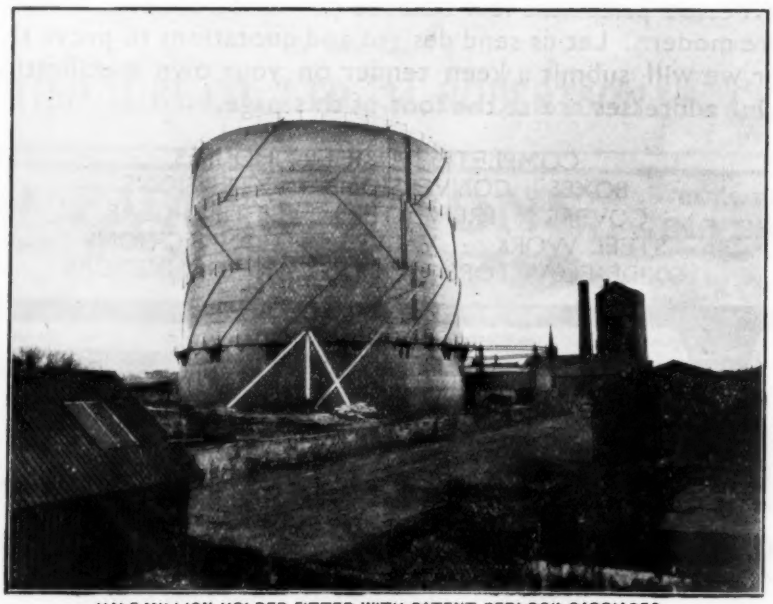

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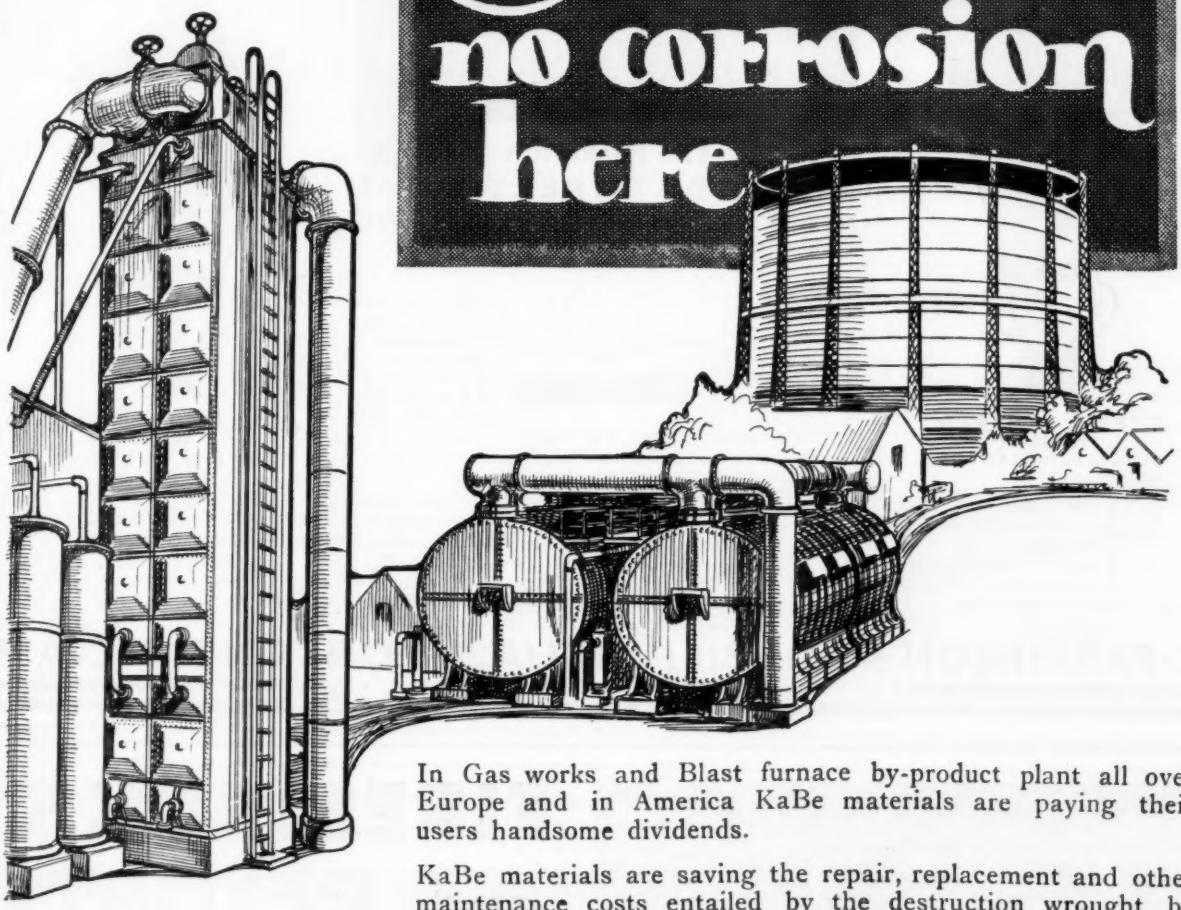

In Gas works and Blast furnace by-product plant all over Europe and in America KaBe materials are paying their users handsome dividends.

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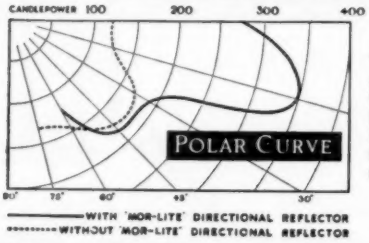
The Parkinson
MOR-LITE DIRECTIONAL REFLECTOR FOR GAS LIGHTING



The curve shows the Directional Increase in Illumination at no extra cost for Gas

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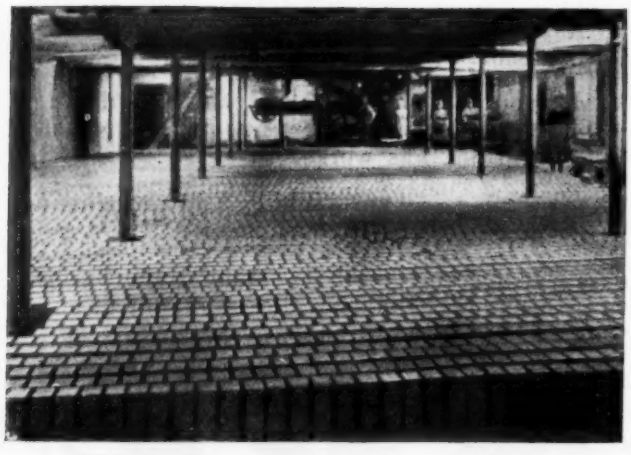

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Nearly a century has passed since the first batch of "GLENBOIG" Firebricks was dispatched.

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ONE WAY ONLY

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In tins for household use at 6d. In 7 lb. drums for use in large kitchens, stove repair depts., etc.

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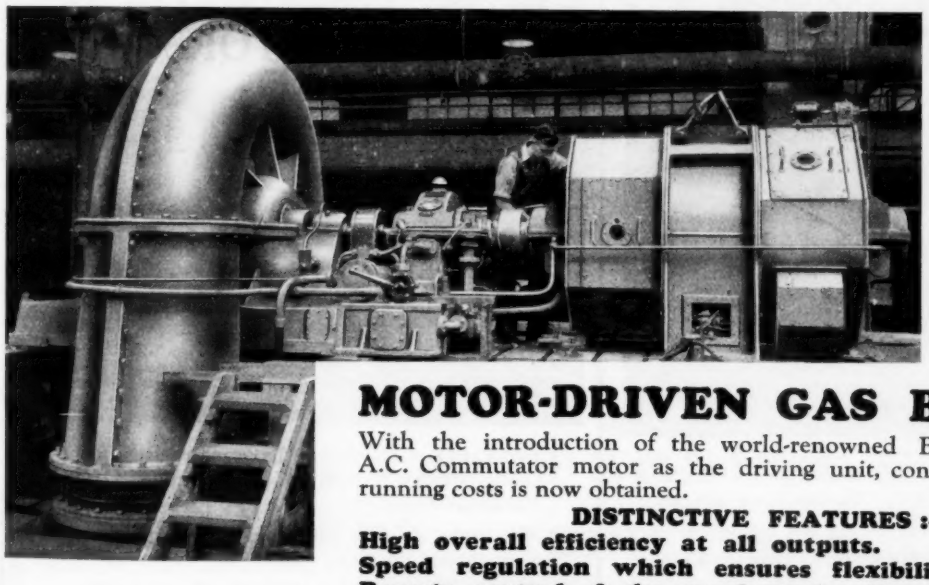

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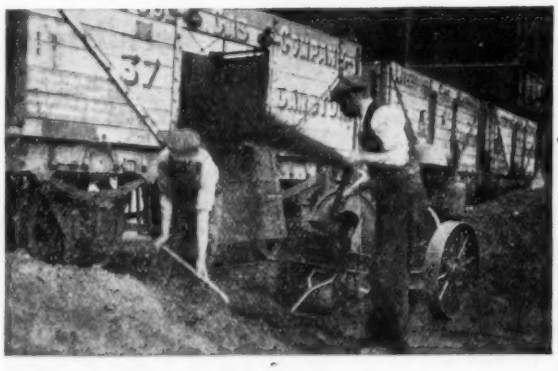

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FITTED TO THE
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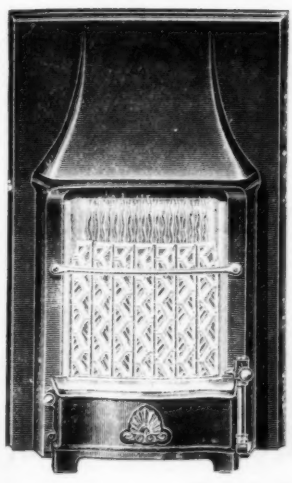

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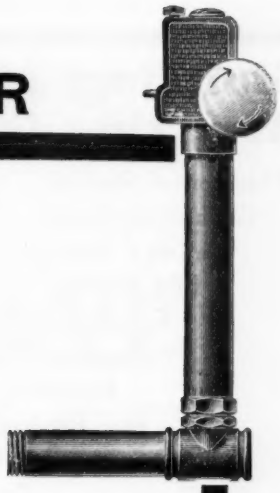

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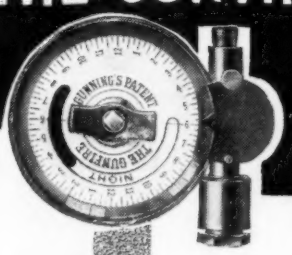

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Delivering 100 cubic feet per hour
has bulk dimensions of
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has bulk dimensions of
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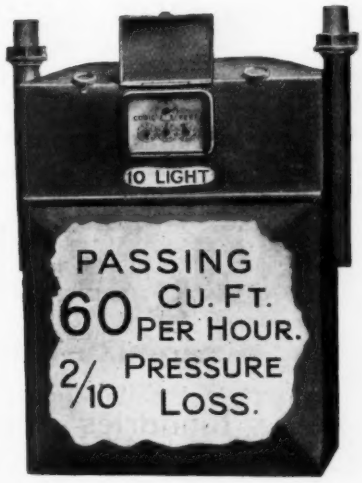

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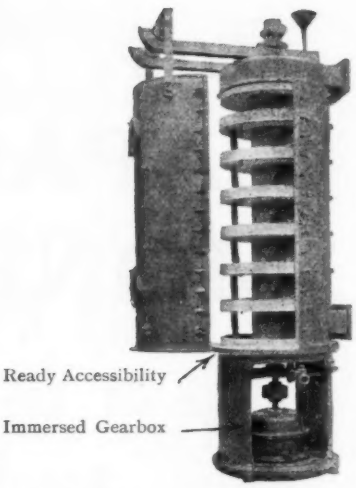

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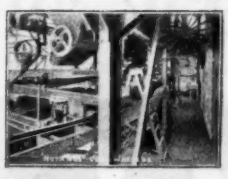

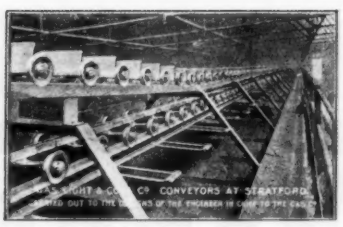

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The test of a good cleaner is not cleaning a patch on an oven door. Try it on the top inside and back of oven and in the corners. Kleenoff will remove the hard baked-on grease from all parts of the oven without rubbing! Kleenoff is non-abrasive and completely odourless; therefore, it cleans without harming the fine surface of enamel linings, and leaves the oven sweet and fresh.

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140 *Therms per ton of coal,* **400** *B.Th.U. Gas*

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THE MOORE GAS PLANT

Produces Coal Gas, Water Gas, or Mixed Gas in any desired proportions

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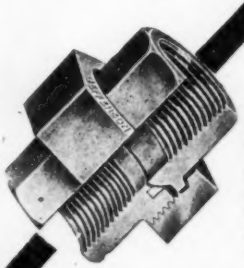

"JEFFERSON" pipe unions are in malleable iron, with ground ball joints having a brass seat pressed in a recess away from the corrosive action of the fluid in the pipe.

Heavy hexagon ends enable rapid tight joints, even with pipes out of alignment, unimpaired by frequent disconnecting, giving unfailing service on all pressures up to 300 lbs. per sq. inch.

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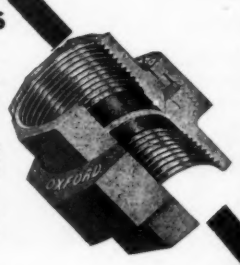

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FOR GAS, STEAM, AND WATER SUPPLIES, PIPE FITTINGS, AND VALVES OF ALL TYPES.

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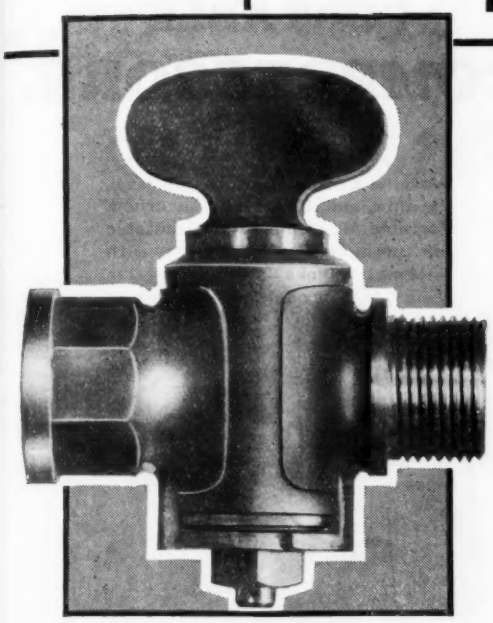

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Automatically Lubricated.
Always Turns Freely.
Always Sound.

THE 'SPERSOM' GAS COCK possesses unique and valuable features of construction.

THE SELF-LUBRICATING FEATURE utilizes the principle of capillary attraction. Consequently oil is fed constantly from a small reservoir in the head of the plug thereby replacing any lost in service.

THE APPLICATION OF THE SPRING LOADING to the plug is carried out in a special manner, which ensures that the plug is always retained on its bearing at a uniform pressure. Dismantling is never necessary.

COCKS FOR ALL PURPOSES can be supplied with these features—Main Service, Gas Fire, Gas Cooker, etc.

"SPERSOM" COCKS ARE ALWAYS SOUND AND SERVICEABLE.

Insist on having your Main Service, Gas Cooker and Gas Fire Cocks made in this new way.

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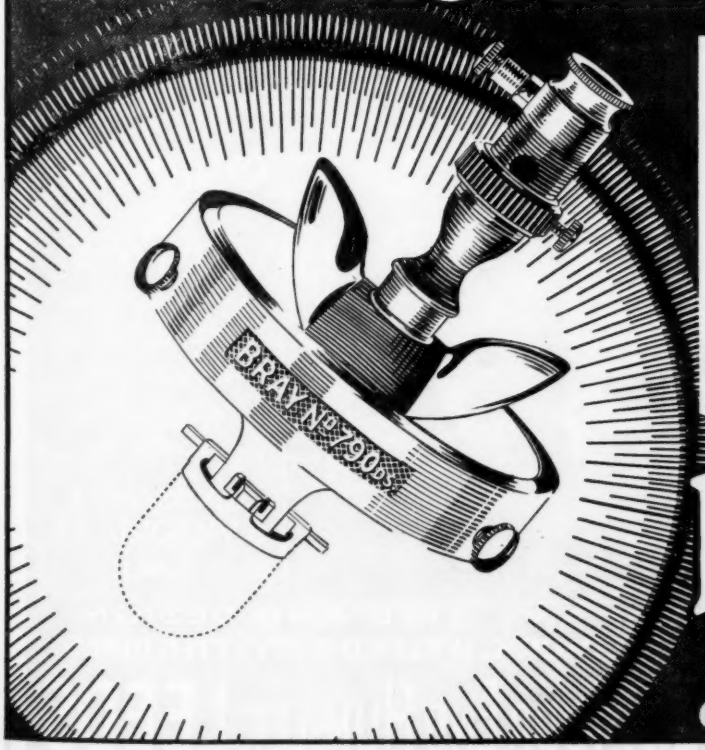

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BRAY SILENT REGULATOR
and
the BRAY PATENTED DIFFUSER.
This combination is the most important advance in incandescent burner design for many years:
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BURNER
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ESTABLISHED 1855.

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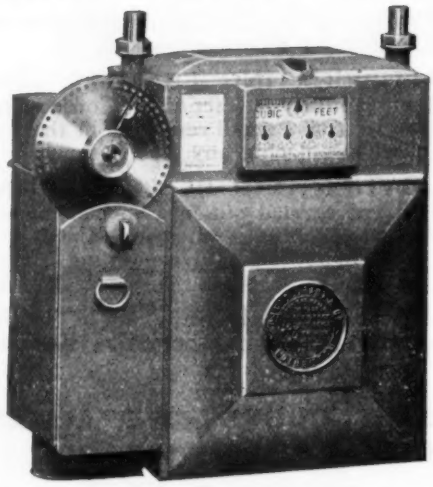

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STANDARD and HIGH CAPACITY METERS

STATION METERS, PRESSURE GAUGES, SYPHON PUMPS.

SLOT METERS Simple, Strong, Compact, Accurate.

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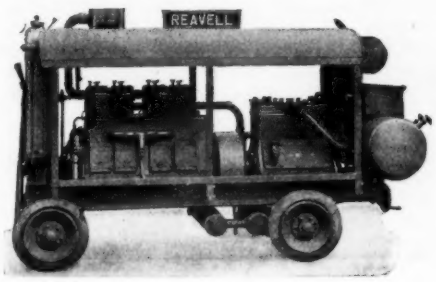

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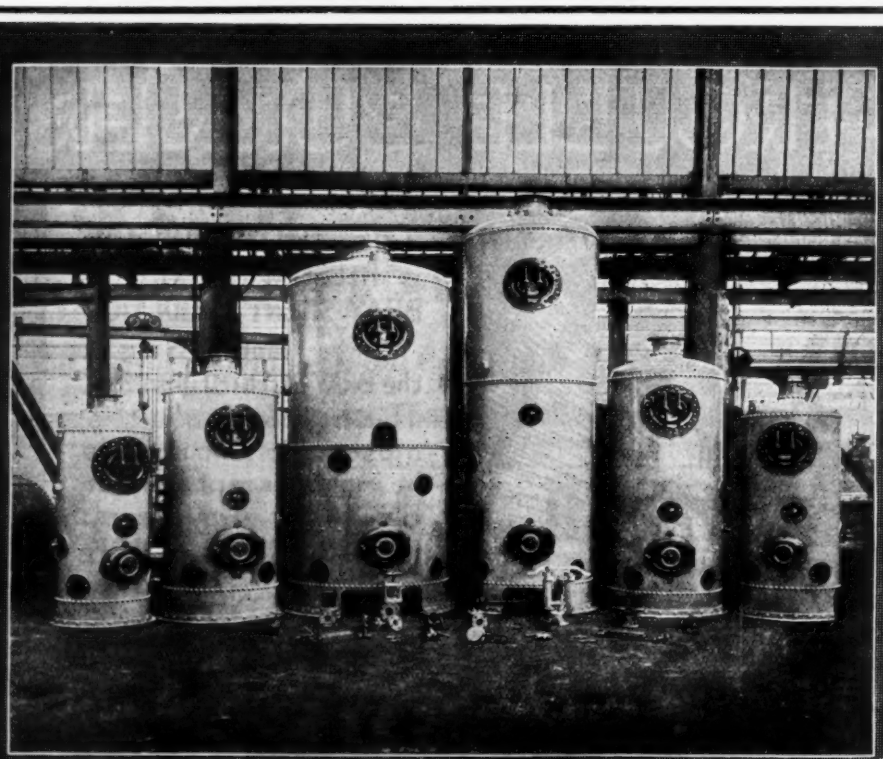

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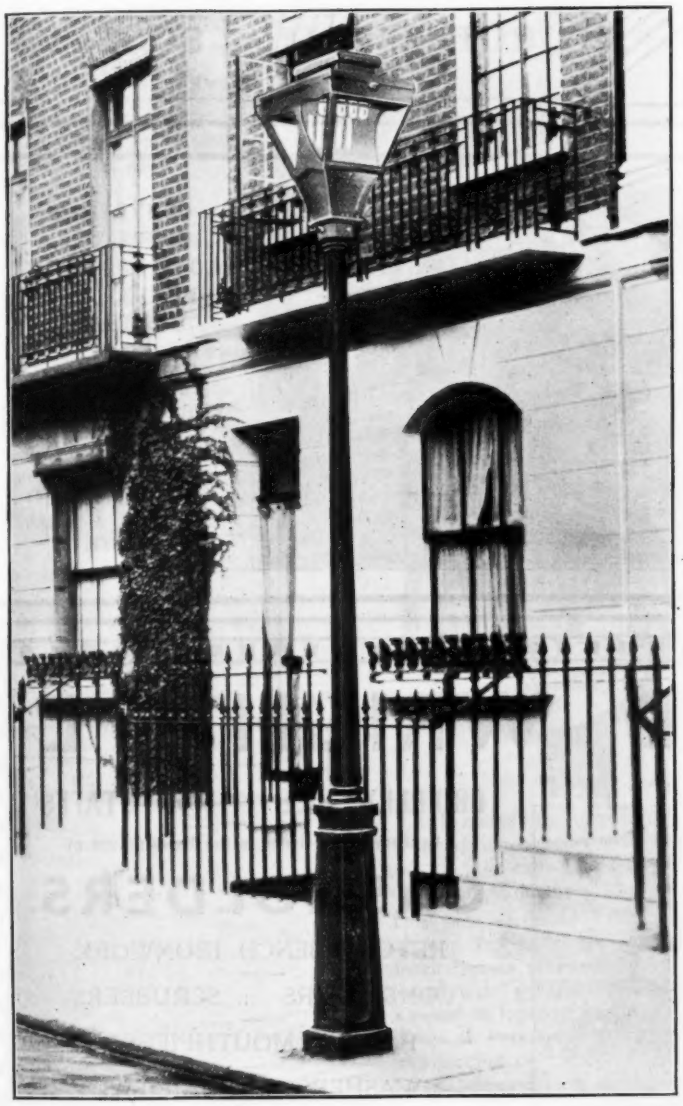

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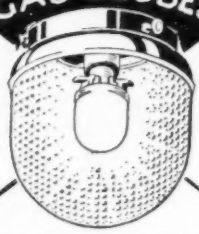

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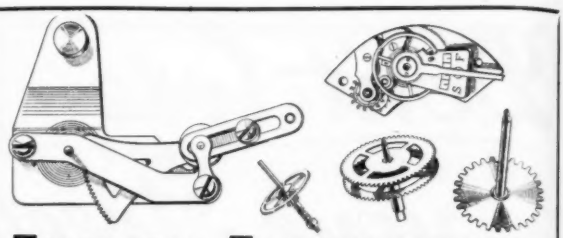

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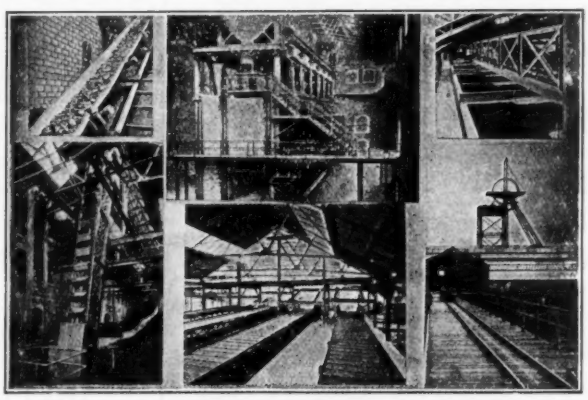

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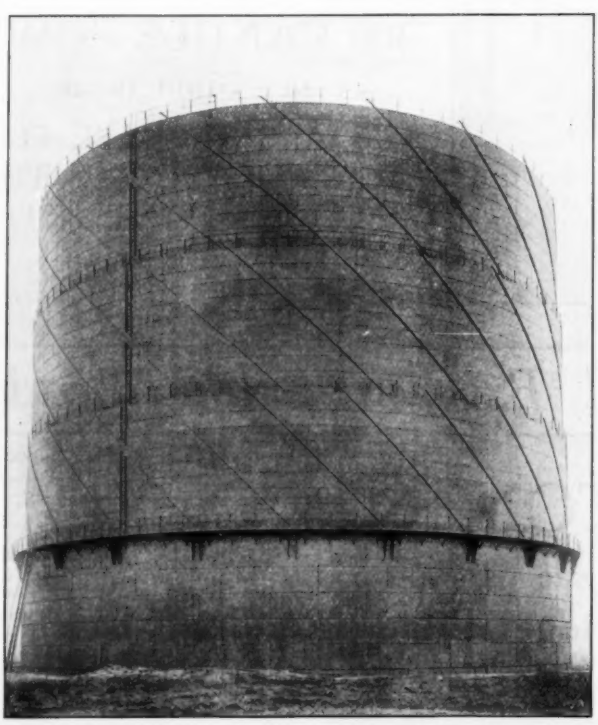

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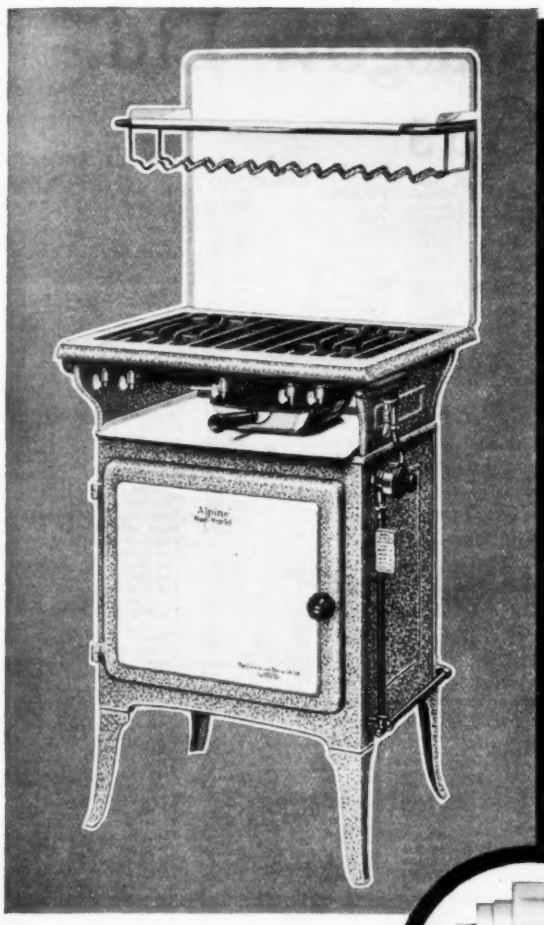

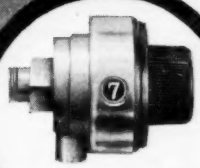

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(trade mark)

The Davis craftwork expresses itself most convincingly in this useful new series of cookers

THE manufacturing prestige built up at Luton is the personal interest and pride of every man employed at the works. Each is willing to give the little extra that seals perfection—that has made the name Davis a hall mark of quality of which the Industry asks nothing more satisfying . . .

This new series of "Alpine" "New World" Cookers provides, in addition to the "New World" features already well established, a distinctiveness of exterior design that is very pleasing, particularly in regard to the generously-planned working space in the oven. The stand is raised on legs to a height that reduces the need for stooping and also allows of very easy cleaning of the floor beneath. The finish is either grey mottled or "Beau," in both cases being of hard "Rado" porcelain enamel, cleaned in a moment.

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"NEW WORLD"
SERIES 2
COOKERS

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GAS STOVE CO. LTD
LONDON & LUTON (*Radiation Ltd Proprietors*)

Humphreys & Glasgow Ltd.
Water-Gas

	Cu. Ft. Daily
Aarhus	800,000
Abertillery	500,000
Abertillery	100,000
Admiralty:	
British	4,000,000
French	1,600,000
Agram	200,000
Airdrie	430,000
Alder-hot	1,400,000
Aldershot	1,000,000
Aldershot	1,316,000
Algiers	1,760,000
Alkmaar	400,000
Allenstein	200,000
Alost	700,000
Amersfoort	300,000
Amsterdam	1,000,000
Amsterdam	1,000,000
Amsterdam	2,700,000
Amsterdam	1,350,000
Antwerp	1,500,000
Antwerp	1,000,000
Antwerp	1,500,000
Antwerp	1,900,000
Arundel	215,000
Ascot	423,000
Ashford	250,000
Athens, Greece	550,000
Augsburg	425,000
Aylesbury	150,000
Aylesbury	470,000
Banbury	200,000
Banff	125,000
Barmen	500,000
Barnsley	588,000
Barrow	300,000
Barrow	500,000
Barry	500,000
Barry	720,000
Bath	1,000,000
Bath	1,000,000
Bath	1,300,000
Bath	1,200,000
Bedford	1,000,000
Belfast	1,700,000
Belfast	4,500,000
Belfast	1,250,000
Belfast	1,250,000
Belfast	2,250,000
Benrath	125,000
Berkhampstead	259,000
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Charlottenb'g	2,500,000
Danziger Str.	1,600,000
Neukoelin	1,350,000
Schmargendorf	761,000
Tegel	10,095,000
Berne, Switz.	725,000
Bexhill	400,000
Bideford	258,000
Bilston	375,000
Bilston	125,000
Birmingham:	
Adderley St.	675,000
Adderley St.	850,000
Nechells	3,000,000
Nechells	3,000,000
Nechells	3,000,000
Nechells	7,650,000
Swan Village	1,500,000
Windsor St.	3,000,000
Windsor St.	3,000,000
Windsor St.	6,100,000
Bishop's Stortford	200,000
Bishop's Stortford	300,000
Bishop's Stortford	200,000
Bishop's Stortford	300,000
Blackburn	1,190,000
Blantyre	150,000
Blois	125,000
Blois	125,000
Bochum	530,000
Bognor	423,000
Bognor	500,000
Bo'ness	125,000
Bo'ness	250,000
Boulogne	340 000
Bournemouth	1,000,000
Bournemouth	500,000
Bournemouth	1,500,000
Bournemouth	1,000,000
Bournemouth	500,000
Bournemouth	1,530,000
Bournemouth	2,000,000
Bournemouth	500,000
Bournemouth	2,750,000
Bradford	1,260 000
Bremen	550,000
Bremen	950,000
Bremen	850,000
Brentwood	250,000
Brescia	588,000
Brescia	588,000
Brest	550,000
Bridgwater	200,000
Bridlington	150,000
Bridlington	200,000
Bridlington	550,000
Brieg	100,000
Brierley Hill	250,000
Brierley Hill	425,000
Brighton	1,750,000
Brighton	1,850,000
Brighton	750,000
Brighton	2,750,000
Brighton	3,000,000
Bristol	2,000,000
Bristol	2,500,000
Bristol	825,000
Bristol	825,000
Bristol	1,500,000
Bromley	1,500,000
Bruges	200,000
Bruges	600,000
Brussels:	
Anderlecht	350,000
Anderlecht	350,000
Forest	1,000,000
Forest	1,000,000
Forest	1,000,000
Forest	1,500,000
Forest	88,000
Koekelberg	1,000,000
St. Gilles	1,000,000

Brussels:	Cu. Ft. Daily
St. Josse	1,000,000
St. Josse	600,000
St. Josse	775,800
Ville	750,000
Ville	750,000
Ville	1,500,000
Ville	350,000
Bucarest	1,100,000
Buckie	164,000
Budapest	50,000
Budapest	1,750,000
Budapest	300,000
Budapest	250,000
Burnley	1,350,000
Caen	250,000
Cambridge	500,000
Cambridge	1,000,000
Cambridge	1,700,000
Cardiff	2,000,000
Cardiff	3,000,000
Cardiff	1,950,000
Cardiff	600,000
Carlisle	600,000
Carlsruhe	500,000
Carnarvon	248,000
Charleroi	1,250,000
Châteauroux	125,000
Châteauroux	125,000
Châtelet	500,000
Chester	564,000
Chesterfield	430,000
Chesterfield	90,000
Chesterton	197,000
Chichester	250,000
Chorley	300,000
Cie. de Béthune	2,145,000
Cie. des Compteurs	1,150,000
Cie. Lorraine de Ch.	210,000
Cie. Mines de Roche	585,000
Coatbridge	400,000
Commercial, L'n	850,000
Commercial	850,000
Commercial	1,250,000
Commercial	2,000,000
Commercial	800,000
Commercial	2,100,000
Copenhagen	700,000
Copenhagen	2,500,000
Copenhagen	1,750,000
Copenhagen	1,200,000
Courtrai	250,000
Coventry	600,000
Coventry	600,000
Coventry	1,000,000
Coventry	1,250,000
Coventry	350,000
Cowdenbeath	420,000
Cracow	400,000
Cranleigh	188,000
Crefeld	500,000
Crewe	700,000
Crewe	800,000
Crosfield & Sons	1,500,000
Crosfield & Sons	1,500,000
Croydon	1,250,000
Croydon	625,000
Croydon	625,000
Croydon	550,000
Croydon	650,000
Croydon	1,125,000
Croydon	150,000
Croydon	3,000,000
Croydon	6,000,000
Deal	250,000
Deal	250,000
Debreczin	100,000
Derby	1,500,000
Derby	2,000,000
Deventer	150,000
Deventer	200,000
Devonport	1,600,000
Devonport	1,100,000
Doncaster	1,350,000
Dorking	150,000
Dorking	300,000
Dorking	130,000
Dover	500,000
Dover	300,000
Dublin	2,000,000
Dublin	2,000,000
Dublin	650,000
Dudley	600,000
Dundee	1,500,000
Dundee	1,650,000
Dundee	900,000
Dunedin, N.Z.	150,000
Dunedin	275,000
Durham	200,000
Dusseldorf	1,000,000
Eastbourne	1,250,000
Eastbourne	1,550,000
Edinburgh	2,000,000
Edinburgh	2,800,000
Eindhoven	1,500,000
Electro-Chimie	650,000
Enschede	282,000
Epping	500,000
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Epsom	300,000
Essen	1,400,000
Essen-Borbeck	1,400,000
Exeter	1,100,000
Exeter	1,200,000
Exmouth	376,000
Falmouth	150,000
Falmouth	200,000
Farnham	300,000
Faversham	200,000
Flensburg	300,000
Flensburg	125,000
Folkestone	1,800,000
Fond. del Pignone	164,000
Forst	300,000
Frankenthal	175,000
Fuel Research Wks.	500,000
Fuel Research Wks.	500,000
Gablonz	140,000
Gas L. & C. Co.:	
Beckton	10,000,000
Beckton	7,000,000
Beckton	3,500,000
Beckton	7,000,000
Beckton	7,000,000

Gas L. & C. Co.:	Cu. Ft. Daily
Beckton	5,250,000
Beckton	4,500,000
Beckton	3,000,000
Beckton	1,500,000
Bow Common	1,000,000
Bow Common	1,150,000
Bow Common	150,000
Brentford	1,200,000
Brentford	1,250,000
Brentford	350,000
Brentford	750,000
Brentford	6,000,000
Bromley	3,750,000
Bromley	2,250,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,450,000
Bromley	1,350,000
Fulham	2,500,000
Fulham	1,700,000
Grays	250,000
Grays	400,000
Grays	725,000
Ilford	650,000
Ilford	750,000
Kensal Green	2,250,000
Kensal Green	2,250,000
Kensal Green	2,250,000
Nine Elms	2,750,000
Nine Elms	750,000
Nine Elms	1,870,000
Nine Elms	2,850,000
Shoreditch	900,000
Shoreditch	2,700,000
Shoreditch	2,725,000
Southall	2,000,000
Southall	3,000,000
Staines	600,000
Stratford	1,700,000
Stratford	850,000
Stratford	2,350,000
Stratford	2,350,000
Gelsenkirchen	525,000
Geneva	500,000
Geneva	700,000
Geneva	1,270,000
Gennevilliers	10,600,000
Gennevilliers	2,900,000
Girvan	235,000
Glasgow	3,000,000
Glasgow	2,500,000
Glasgow	2,250,000
Glossop	340,000
Gloucester	800,000
Gloucester	1,000,000
Gosport	200,000
Gosport	225,000
Göteborg	300,000
Göteborg	600,000
Göteborg	1,000,000
Graudenz	200,000
Groningen, Holland	500,000
Groningen	1,250,000
Guest Keen & P.	1,936,000
Guildford	350,000
Guildford	200,000
Guildford	350,000
Guildford	1,100,000
Guildford	150,000
Haarlem	850,000
Hamburg	1,750,000
Hampton Court	500,000
Hampton Court	600,000
Hampton Court	1,100,000
Hanley	800,000
Hanley	850,000
Hartlepool	750,000
Hartlepool	765,000
Hastings	1,250,000
Haywards Heath	470,000
Haywards Heath	500,000
Hebden Bridge	200,000
Heidelberg	200,000
Hereford	525,000
Hertford	197,000
Hertford	244,000
Hessle	150,000
Heywood	500,000
High Wycombe	752,000
Hilversum	850,000
Hilversum	1,000,000
Hinckley	250,000
Hoehead	197,000
Hong Kong	450,000
Hong Kong	450,000
Hornsey	1,000,000
Hornsey	1,000,000
Hornsey	750,000
Hornsey	750,000
Horsham	235,000
Houillère de Lievin	2,900,000
Hull	1,500,000
Hull	1,000,000
Hull	1,600,000
Innsbruck	200,000
Ipswich	750,000
Ipswich	1,250 000
Ipswich	600,000
Jersey	564,000
Jersey	564,000
Kampen	350,000
Karlsbad	350,000
Kendal	329,000
Kidsgrove	235,000
Kiel	1,000,000
Kiel	880,000
Kilmarnock	500,000
Kilmarnock	585,000
King's Lynn	197,000
King's Lynn	400,000
Kingston-on-Th	3,400,000
Kirkintilloch	360,000
Kirkintilloch	827,000
Kolozvar	100,000
Lancaster	500,000
Langley Mill	500,000
Largs	235,000
Lausanne	250,000
Lausanne	385,000
Lausanne	970,000
Lea Bridge	350,000
Lea Bridge	350,000

Lea Bridge	Cu. Ft. Daily
Lea Bridge	400,000
Lea Bridge	1,000,000
Lea Bridge	1,500,000
Lea Bridge	1,530,000
Leamington	600,000
Leamington	525,000
Leatherhead	705,000
Leeds	1,500,000
Leeuwarden	400,000
Leicester	2,700,000
Leiden	500,000
Leiden	575,000
Leigh	350,000
Lemberg	260,000
Lemberg	500,000
Letchworth	362,000
Letchworth	423,000
Liége	1,000,000
Liége	750,000
Lille	860,000
Lincoln	500,000
Lincoln	893,000
Littlehampton	500,000
Liverpool	3,500,000
Liverpool	4,500,000
Liverpool	750,000
Liverpool	1,750,000
Liverpool	1,250,000
Liverpool	3,000,000
Liverpool	1,500,000
Liverpool	1,250,000
Liverpool	2,350,000
Liverpool	3,000,000
Liverpool	8,600,000
Long Eaton	430,000
Long Eaton	170,000
Longton	600,000
Louvain	800,000
Lubeck	400,000
Luton	400,000
Luton	300,000
Maastricht	200,000
Macclesfield	800,000
Magdeburg	1,400,000
Maidenhead	225,000
Maidenhead	225,000
Maidenhead	175,000
Maidenhead	175,000
Maidenhead	200,000
Maidenhead	200,000
Maidstone	500,000
Maidstone	500,000
Malines	500,000
Malines	575,000
Malmö	350,000
Malta	400,000
Manchester	3,500,000
Manchester	3,500,000
Manchester	1,500,000
Mansfield	330,000
Mansfield	493,000
Margate	960,000
Marlborough	100,000
Mayence	700,000
Melbourne	5,000,000
Merthyr Tydfil	300,000
Merthyr Tydfil	200,000
Middlesbrough	1,250,000
Middlesbrough	750,000
Middlesbrough	900,000
M.M. Woolston	9,000,000
Minehead	300,000
Monaco	275,000
Monaco	618,000
Monaco	618,000
Monaco	400,000
Complete Gasification	
Mons	500,000
Montevideo	1,222,000
Morecambe	333,000
Moscow	1,000,000
Munich	1,400,000
Namur	175,000
Narbonne	350,000
Nelson	400,000
Nelson	350,000
Neuchatel, Switz.	250,000
Neuss	140,000
Newbury	250,000
Newcastle	2,500,000
Newcastle, N.S.W.	500,000
Newhaven	235,000
Newport Pagnell	188,000
Nice	900,000
Nice	1,245,000
Nictheroy	250,000
Nimes	420,000
North Middlesex	780,000
North Middlesex	780,000
North Middlesex	1,000,000
North Middlesex	1,000,000
North Middlesex	800,000
Complete Gasification	
North Middlesex	900,000
2nd Complete Gasification	
North Sydney	500,000
North Sydney	500,000
Norwich	1,000,000
Norwich	300,000
Norwich	500,000
Norwich	1,500,000
Nottingham	1,000,000
Nottingham	1,000,000
Nuneaton	125,000
Oberhausen	175,000
Oldbury	500,000
Oldenburg	200,000
Ormskirk	170,000
Ostend	100,000
Ostend	200,000
" Zandvoorde	700,000
Oxford	4,500,000
Palermo	968,000
Palermo	850,000
Paris:	
Clichy	4,000,000
Ivry	2,355,000
Landy	6,000,000
Landy	6,000,000
Landy	5,255,000
La Villette	4,000,000
La Villette	2,000,000
La Villette	2,000,000

Paris-Plage	Cu. Ft. Daily
Pau	125,000
Pavie	350,000
Pavie	194,000
Pavie	212 000
Pembroke	240,000
Perigueux	350,000
Perth, W.A.	125,000
Perth, W.A.	1,000,000
Petone, N.Z.	200,000
Piggott & Co.	1,500,000
Plymouth	2,000,000
Poitiers	350,000
Pontypool	120,000
Port Elizabeth	400,000
Portsmouth	1,000,000
Portsmouth	2,000,000
Portsmouth	800,000
Portsmouth	2,000,000
Posen	450,000
Posen	700,000
Prague	140,000
Preston	1,400,000
Ramsgate	430,000
Reading	1,000,000
Reading	1,000,000
Reading	600,000
Redditch	500,000
Redhill	275,000
Redhill	300,000
Redhill	1,100,000
Redhill	625 000
Reichenberg	400,000
Reval	350,000
Rhymney	175,000
Rhymney	250,000
Riddings	258,000
Ripley	120,000
Rochester	2,200,000
Rochester	2,800,000
Romford	300,000
Romford	350 000
Romford	1,200,000
Rotterdam	850,000
Rotterdam	1,500,000
Rotterdam	750,000
Rotterdam	750,000
Rotterdam	600,000
Rotterdam	2,000,000
Rotterdam	500,000
Roulers, Belgium	250,000
Royston (Yorks.)	250,000
Rugby	1,000,000
Rugby	450,000
Rushden	425,000
Rushden	517,000
Rushden	225,000
Ryde	600,000
Ryde	600,000
Saffron Walden	235,000
St. Albans	700,000
St. Albans	580,000
St. Albans	1,500,000
St. Andrews	210,000
St. Andrews	409,000
St. Gallen	225,000
St. Gallen	225,000
St. Nicolas, Belgium	250,000
Sté. Ch.Gr. Paroisse	1,320,000
Sté. Ch Gr Paroisse	2,900,000
Sté. I. & F. de Lens	1,130,000
Sté. I. & F. de Lens	1,130,000
Sté. Kuhlmann	1,285,000
Sté. Kuhlmann	3,200,000
Sté. Kuhlmann	2,150,000
Sté. Kuhlmann	3,830 000
Sté. Tubes Meuse	545,000
San Paulo	700,000
Scarborough	800,000
Scarborough	200,000
Scarborough	350,000
Scarborough	1,300,000
Scarborough	1,350,000
Seaford	200,000
Shanghai	225,000
Shanghai	225,000
Shanghai	1,000,000
Shanghai	2,200,000
Shankiin	259,000
Shanklin	400,000
Sheerness	200,000
Sheerness	180,000
Sheerness	200,000
Sheerness	220,000
Sheffield	1,530,000
Sheffield	3,000,000
" Steel Prods.	3,000,000
Shirebrook	500,000
Shrewsbury	300,000
Shrewsbury	170,000
Sidmouth	225,000
Singapore	600,000
Sittingbourne	259,000
Southampton	800,000
Southampton	500,000
Southampton	600,000
Southampton	100,000
Southampton	1,000,000
Southampton	1,450,000
Southend	1,250,000
Southend	900,000
Southend	900,000
Southend	600,000
Southgate	400,000
Southgate	500,000
Southgate	800,000
Southgate	500,000
Southport	750,000
Southport	900,000
Southport	900,000
Southport	450,000
South Shields	650,000
South Shields	1,250,000
Stafford	500,000
Stafford	750,000
Stettin	880,000
Steyning	150,000
Stirling	400,000
Stirling	970,000
Stockholm	1,500,000
Stockholm	1,750,000
Stockport	600,000
Stockport	600,000
Stockport	400,000

Stockport	Cu Ft. Daily
Stockton	400,000
Stockton	500,000
Stockton	250,000
Stourbridge	500,000
Stourbridge	500 000
Sunderland	2,250,000
Sunderland	300,000
Sunderland	475,000
Sutton	1,269,000
Sutton	1,625,000
Swanage	300,000
Swansea	750,000
Swansea	1,000,000
Swansea	450,000
Swansea	1,250,000
Swansea	2,000,000
Swindon	300,000
Swindon	450,000
Swindon	400,000
Sydney	1,000,000
Sydney	1 000,000
Sydney	1,000,000
Sydney	1,000 000
Sydney	8,250,000
Sydney	2,750,000
Taunton	225 000
Taunton	350,000
Tawe Valley	275,000
Teignmouth	300 000
The Hague	1,000,000
The Hague	500,000
The Hague	1,750,000
The Hague	1,500,000
The Hague	775,000
The Hague	1,500,000
The Hague	2,930,000
Tilburg	400,000
Tirlemont	125,000
Tokyo	2,000,000
Torquay	350,000
Torquay	350,000
Torquay	320,000
Tottenham	750,000
Tottenham	750,000
Tottenham	350,000
Tottenham	1,000,000
Tottenham	1,000,000
Tottenham	1,250,000
Tottenham	2,500,000
Tottenham	1,000,000
Tottenham	500,000
Tottenham	1,000,000
Toulouse	1,800,000
Toulouse	785,000
Toulouse Natl. Wks.	2,400,000
Toulouse Natl. Wks.	6,206,000
Toulouse Natl. Wks.	3 730,000
Tournai	700,000
Tours	550,000
Trowbridge	250,000
Trowbridge	150,000
Tunbridge Wells	1,000,000
Tunbridge Wells	1,000,000
Tunis	175,000
Tynemouth	1,100,000
Tynemouth	1,100,000
Ulm	400,000
Union Chim.-Belge	1,977,000
Utrecht	1,000,000
Utrecht	1,000,000
Uxbridge	752,000
Uxbridge	1,000,000
Vancouver	3,800,000
Verviers	1,000,000
Vevey, Switz.	350,000
Victoria, B.C.	500,000
Vienna	3,500,000
Vienna	2,500,000
Walsall	750,000
Walsall	375,000
Waltham	400,000
Waltham	140,000
Walton-on-Thames	970,000
Wandsbek	125,000
Wandsworth	1,800,000
Wandsworth	4,230,000
Wanganui, N.Z.	376,000
Ware	150,000
Ware	282,000
Warwick	125,000
Wasmuel	500,000
Watford	300,000
Watford	350,000
Watford	400,000
Watford	1,250,000
Wath	430,000
Weimar	100,000
Wellingborough	525,000
Wellingborough	525,000
Wellingborough	550,000
Wellington, N.Z.	350,000
Wellington	350,000
West Bromwich	550,000
Westgate	250,000
Weston-Mare	350,000
Weston-Mare	350,000
Weston-Mare	150,000
Weston-Mare	150,000
Weston-Mare	500,000
Wexford	100,000
Weymouth	400,000
Weymouth	100,000
Weymouth	658,000
Whitstable	423,000
Widnes	500,000
Wiesbaden	850,000
Wigston	250,000
Winchester	225,000
Winchester	125,000
Winchester	410,000
Winchester	325,000
Woking	400,000
Wolverhampton	1,500,000
Wolverhampton	1,000,000
Wolverhampton	250,000
Wolverhampton	400,000
Worthing	525,000
Yarmouth	500,000
Yarmouth	125,000
Yeovil	340,000
Zwolle	200,000
Zwolle	200,000
Zwolle	700,000

942 *Sets of Humphreys-Glasgow Plant have been (and are being) installed with a capacity of over* **834,000,000** *cubic ft. of Water-Gas per diem. Including the work of their American Colleagues,* **2062** *Sets have been constructed with a total* **Daily** *capacity of* **2,283,000,000** *cubic feet.*

Humglas House, Carlisle Place, London, S.W.1.

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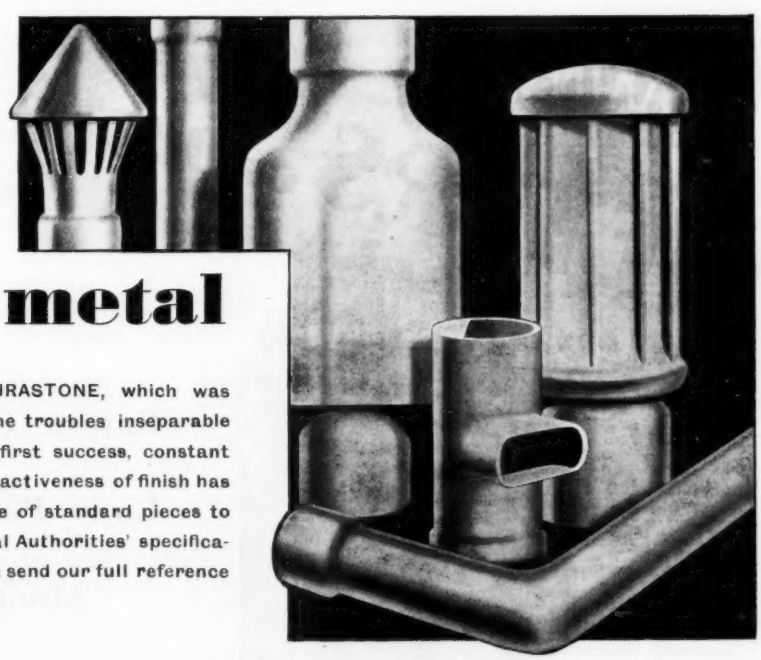

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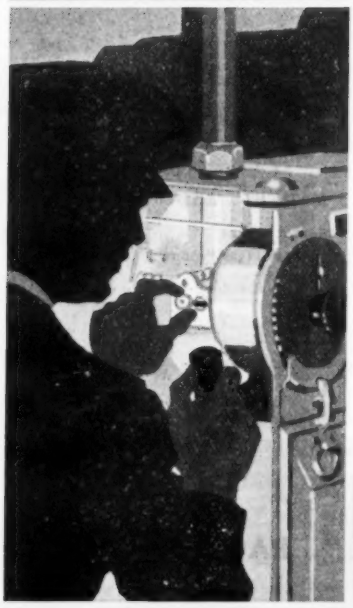

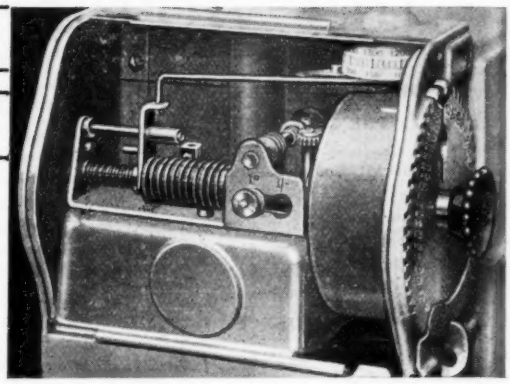

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THE GAS JOURNAL

SEPTEMBER 6, 1933

Vol. 203. 85th Year No. 3668

A Glance at the Contents—

Our Technical Signpost.

A Technical Signpost to Vol. 202 of the "JOURNAL," April-June, 1933, commences on p. 509.

Gas Manager Required in Scotland.

The Forres Gas Light Company, Ltd., invite applications for the position of Gas Manager. [p. 520.]

Post Vacant.

A Rental Superintendent is required by the South Suburban Gas Company. The salary will not be less than £650 per annum. [p. 522.]

Ha! The Onion!

"Dedicated, in all humility, to a 'doubting Thomas,'" "Iso-Candles Made Easy," by Dr. J. W. T. Walsh, is an unusual and exceedingly welcome contribution to the science of illumination. [p. 506.]

Rational Examination of Coal.

Dr. Wilfrid Francis condemns any system of classification or any method of examination of coal which fails to consider the type of coal and the nature of the ingredients present. It is lamentable, he says, that so much money and energy are being devoted to the ultimate and proximate analyses of coal under national auspices, while the development of rational methods of examination and classification is being left to individual effort. [p. 514.]

Vacancy for Gas and Water Engineer and Manager.

Applications are invited for the position of Gas and Water Engineer and Manager to the Milford Haven U.D.C., at a commencing salary of £280 per annum. [p. 520.]

Engineer and Manager for North Devon.

At a commencing salary of £600 per annum, the position of Engineer and Manager to the Ilfracombe Gas Company is vacant, and the Company invite applications from those not exceeding 40 years of age. [p. 520.]

Street Lighting and Safety.

In his Presidential Address at the Annual Conference of the Association of Public Lighting Engineers, Mr. E. M. Severn, of the South Metropolitan Gas Company, emphasizes the relationship between good lighting and safety, and urges the education of public opinion on this matter. [p. 513.]

Portsmouth's New Plant.

New plant was inaugurated at the Hilsea Works of the Portsmouth and District Gas Company on Monday of this week. The carbonizing unit consists of Woodall-Duckham intermittent vertical chamber ovens, and special attention has been paid to coke cutting and grading. As re-modelled and extended the Hilsea Works has a nominal maximum daily production of 7 million c.ft. of coal gas and 3,750,000 c.ft. of water gas. [p. 501.]

Forthcoming Engagements

Sept. 8-Oct. 16.—I.G.E.—Visit to Canada and the United States of America.

Sept. 8.—I.G.E.—Council Luncheon at the Shipping, Engineering, and Machinery Exhibition, Olympia. Members' tea at the Exhibition.

Sept. 12.—NATIONAL GAS COUNCIL CENTRAL EXECUTIVE BOARD.—Meeting at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m.

Sept. 21.—WALES AND MONMOUTHSHIRE ASSOCIATION.—Meeting at Porthcawl.

Sept. 22.—I.G.E.—Meetings of Liquor Effluents and Ammonia Sub-Committee, 10.30 a.m.; Joint Research Committee, 2.45 p.m., 28, Grosvenor Gardens, S.W. 1.

Sept. 25-27.—B.C.G.A.—Annual Conference at Bournemouth.

Sept. 29.—I.G.E.—Meeting of General Research Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 17.—I.G.E.—Meetings of Board of Examiners, 2.30 p.m.; Publications Committee, 3 p.m.; Education Executive Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.

Nov. 6.—I.G.E.—Meetings of Finance Sub-Committee, 2 p.m.; Membership Sub-Committee, 2 p.m.; General Purposes Committee, 3 p.m.; Council, 4.15 p.m., 28, Grosvenor Gardens, S.W. 1.

Nov. 7-8.—I.G.E.—Autumn Research Meeting, Institution of Mechanical Engineers.

Nov. 9.—S.B.G.I.—Autumn General Meeting, Hotel Metropole, London.

Nov. 14.—I.G.E.—Session at the Public Works, Roads, and Transport Congress and Exhibition, Royal Agricultural Hall, 11 a.m.; Joint Session of the Institution and the Association of Public Lighting Engineers, 3 p.m.

Nov. 14.—I.G.E.—Meeting of Gas Education Committee, 5 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 11.—I.G.E.—Meetings of Finance Sub-Committee, 2 p.m.; Membership Sub-Committee, 2 p.m.; General Purposes Committee, 3 p.m.; Benevolent Fund Committee of Management, 4.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 12.—I.G.E.—Meetings of Council, 10 a.m.; Gas Education Executive Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.

Dec. 21.—I.G.E.—Meeting of Refractory Materials Joint Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

1933 "JOURNAL" Directory.

Page 8. BISHOP'S STORTFORD. W. C. Kimpster, Engineer and Manager, deceased.

Page 24. ELY. T. A. Guyatt, Engineer, Manager, and Secretary, deceased.

Page 40. LITTLEPORT. T. A. Guyatt, Engineer and Manager, deceased.

EDITORIAL NOTES

Light Reading

WE have been fortunate in prevailing upon Dr. J. W. T. Walsh to write an article, exclusive to the "JOURNAL," on the new method of determining the candle-power distribution of a modern asymmetric lighting unit; and we think our readers will enjoy this article as well as benefit by it. The author has a nimble wit and a facile style; he is also an eminent authority on illumination. His explanation of the *raison d'être*, construction, and use of the "onion diagram" is both lucid and fascinating. The explanation is dedicated to a "Doubting Thomas;" but even the "scholar from Rye who heaved a d↓" could not sigh while reading this article, which sheds such a clear ray of light on what at first may appear a dull and abstruse technical problem. Dr. Walsh has given us a little "light" reading, and the onion diagram can no longer be deemed a cause for tears.

Intermittent Vertical Chambers at Portsmouth

QUITE a number of gas undertakings, more especially in the South of England, have in recent years adopted the intermittent vertical type of carbonizing plant. The attraction of this type of plant is apparently its capability of giving a high thermal yield from highly caking slack coals, and of securing at the same time a coke of good regular quality. The latest example of this tendency is afforded by the new carbonizing plant at the Hilsea Works of the Portsmouth Gas Company, which was inaugurated by the Lord Mayor of Portsmouth last Monday. The Directors of the Company were influenced in their decision to adopt intermittent vertical chambers by the cheapness of seaborne Durham coals. Even when allowance had been made for the cost of handling and transport to Hilsea from their Flathouse wharf, they found that the Durham seaborne coals would be cheaper than railborne coal.

The new plant, which is fully described and illustrated elsewhere in this issue of the "JOURNAL," comprises a large bench of 35 Woodall-Duckham intermittent vertical chambers, arranged in five settings of seven chambers, each setting being complete with its own producer and recuperator. The whole bench has a total gas-making capacity of about 4 million c.ft. a day, using about 250 tons of coal. The bench is served with coal by a comprehensive handling plant erected in an adjacent coal store. It is a matter for congratulation to Mr. T. Carmichael, the Engineer and Manager of this progressive Company, that, although the new plant is built within an existing retort house, the result is thoroughly effective both inside and outside. A conversion of this sort is apt to result in a somewhat hybrid external aspect. This is not the case at Hilsea, and, if and when the bench is extended to replace the remaining horizontal retorts, a well-balanced building will be secured.

It is noticeable that inside the house the plant is laid out with special thought for ease of supervision, inspection, and operation. Generous galleries, stairs, and platforms are provided, and the control instruments are brought together at two convenient points, the main controls being grouped on a panel in the well-designed boiler and pump house adjacent to the retort house, and another small instrument board being provided for the operators at the top of the setting level. Attention to details in design such as these goes a long way towards encouraging efficient retort house control. Due consideration has been given to fuel economy, and the plant is equipped with a waste-heat boiler capable of supplying its full steam requirements, including the steaming of the charges.

A strong feature of the installation which we feel merits special attention is the provision which has been made for the production of good coke of regular quality. The coke quenching arrangements, for instance, are designed to ensure that a predetermined but variable quantity of water is automatically discharged on each skip load of hot coke, and, in order that this quantity need not be more than is necessary for general quenching, an elevated coke wharf has been installed on which the coke is allowed to cool after quenching, and "spot" quenching can be effected if required. Furthermore the Company have installed a comprehensive coke cutting and grading plant. In the design of this plant their engineers have secured a large measure of flexibility in operation, and have paid very special attention to the removal of breeze caused by storage of the graded coke. Thus they have ensured that the final coke product will meet the most exacting requirements of their consumers. The installation of this new plant at Hilsea is consonant with the progressive policy of the Portsmouth Gas Company, which has always been directed towards a high degree of technical efficiency in both manufacturing and distributing plant. That this policy has been justified by the development of the Company is amply shown by the facts that their consumers are about seven times as numerous as they were forty years ago, and their make of gas is more than four times as great. For an old-established centre of population such as Portsmouth, this is no mean rate of increase. It is gratifying, too, to be able to record that since 1921, in spite of the labour savings made by the increasing mechanization of their works, the number of their employees has risen from 686 to 936 persons.

Adaptability

THIS new Woodall-Duckham plant at Portsmouth affords further proof that a firm whose name has been particularly associated with the development of the continuous vertical retort since its inception has added materially to its "stock-in-trade" by the design of intermittent vertical chambers. Mr. Thorman's paper on the Southall plant, the Institution of Gas Engineers' Gas Investigation Committee report, and Mr. Grogono's contributions on the Croydon plant, have each emphasized to the Industry the success of these recent innovations in gas manufacture.

This spirit of progress and adaptability among some of our leading contractors is of no small importance to the success of the Gas Industry. Behind the launching of each new design there must lie much thought and work—probably little appreciated by those who see the plant as a *fait accompli*, in operation, and producing its millions of cubic feet of gas a day. Without this pioneer work on the part of plant designers who set out to improve existing practice, and of gas engineers who have the enterprise to take advantage of progress in technique, gas production would not be in its present state of high efficiency. The pages of the "JOURNAL" show that among these firms the Woodall-Duckham Company plays an important part in presenting to the Industry improvements in fuel technology.

Lighting and Safety

THE dangers from fast-moving traffic render it imperative to have adequate artificial illumination, and we have a long way to go yet before we can be satisfied that this illumination is adequate. There can be no doubt that the considerable variation in the standard of lighting which exists throughout the country is responsible for a large proportion of the accidents which occur after dark; and unless the illumination is sufficient to render the use of dazzling headlights unnecessary, the risks of accidents will increase. In this regard, to show what good lighting can accomplish, Mr. E. M. Severn, of the South Metro-

XUM

politan Gas Company, in his Presidential Address to the Association of Public Lighting Engineers, quotes the results of his Company's re-lighting with high power gas lamps a section of roadway which carries the bulk of traffic from the West End of London to the suburbs. It has been concluded that to-day the relative night hazard is about four times the day hazard. This fact should be brought home to the public generally and to lighting authorities in particular.

We must have better lighting, and a most excellent way of exciting public interest in the matter is to stage demonstrations of good gas lighting. The South Metropolitan Gas Company provided an example of the merits of this method when, three years ago, they demonstrated on a mile of main road the possibilities of a modern system of lighting by high-power gas lamps centrally suspended over the road. As a result of the experiment, a considerable extension of the system was called for, and twenty-six miles of main road in South London are now lit by nearly 1000 lamps (each of 1000 c.p.). This system of lighting has received the unqualified approval of motorists and pedestrians alike. Greater realization by the public of what constitutes good lighting and what it means to the cause of safety should synchronize with an increase in gas sales, for any idea that gas as an illuminant in this country is inferior to any other is unfounded. Public gas lighting is on the increase, as the Board of Trade Return for 1932, referred to in these columns last week, testifies; and lighting authorities have no greater duty than to adopt means to minimize the " toll of the road."

To indicate how the Gas Industry has kept abreast of changing conditions, Mr. Severn mentions that in 1899 the streets of South London were illuminated with a value equivalent to that afforded by 28,000 candles; in 1932 the figure had increased to approximately 3,453,160 candles; and so efficiently is gas used for lighting to-day, that this 120-fold increase in the light distributed over the highways of South London has been achieved by an approximate increase of only 10% in the gas used for that purpose. What is true of South London is typical of many other cities and towns. And in the progress of lighting generally in recent years the Association of Public Lighting Engineers has played a conspicuous rôle. During the decade since its inauguration it has increased vastly in strength and status; and the latest move of the Council in regard to membership, referred to by Mr. Severn, an extract of whose address will be found on later pages, is all to the good.

Analysis of Coal

We conclude to-day a contribution, commenced in the " Journal " last week, which will appeal to all who have tried to penetrate the mysteries of the raw material of the Gas Industry—coal. The author, Dr. Wilfrid Francis, in a letter to the " Journal " for March 9 of last year, took the Industry to task for neglecting to study the correlation between chemical constitution of coal and the nature and amount of gas yielded on destructive distillation. " The idea is prevalent," he said, " that all coals within certain limits of rank are equally suitable for the Industry. Post-war research on coal is ahead of the Industry in this respect, since new methods are now available for the examination of coal which show that considerable differences in properties may be present in coals of the same ultimate and proximate analysis. These methods have been termed methods for the ' rational analysis ' of coal, and a research of great value would be to apply them to the evaluation of coals for the Gas Industry." This " rational examination " is the subject of the present contribution.

Coal is a complex mass, argues Dr. Francis, and it contains a number of known types of chemical compounds. The properties of any coal depend upon the properties of these compounds, upon the proportions of the latter present, and upon the stage in the process of coalification reached by the coal mass. The proportions of the ingredients present in a coal can be measured—the resins and hydrocarbons may be removed by solvent extraction, leaving the " coal residue," which consists of ulmin, opaque matter, and plant skins. In turn, the relative proportions of true ulmin and opaque matter can be determined. These measurements are essential if we are to gauge a coal accurately—*i.e.*, to rank it. And the author shows that the ultimate analysis of a coal, without reference to its " rational " analysis, is a very poor guide to either its rank or properties. Seyler's classification, he maintains, fails because the tests made give no information regarding the chemical characteristics of coal, " which is treated as though it consisted of so many units of carbon, so many units of hydrogen, mixed in any haphazard manner; instead of which these elements are contained in several definite types of compounds having different properties and occurring in varying proportions." Coals of the same ultimate analysis may have different density, hardness, type of flame, amount of volatile matter, amount and type of products of distillation, and coking properties. The error in determining rank from the ultimate analysis of an average sample of coal may be as great as 1%. " One is consequently justified in stating categorically that the rank of a coal is defined accurately by the carbon content of the vitrain present, and that little reliance can be placed upon the determination of rank by ultimate analysis of run-of-mine or average samples of coal."

The author, summing up his case, states that we are now in a position to survey the coals of this country in a scientific manner so that the most suitable coal for any industrial purpose may be found. Knowing the influence of rank upon the properties of the ulmins, knowing the properties of the ingredients, and having available methods for measuring the rank of ulmin and the proportions of ingredients present, the mode of application of the rational examination of coal to commercial problems should be clear, especially in its application to the gas-making, low-temperature carbonization, and coking industries. Dr. Francis roundly condemns any system of classification or any method of examination of coal that fails to consider the type of coal and nature of the ingredients present. The coal industries of the leading nations are languishing for lack of the knowledge to enable better use to be made of their coal resources; yet enormous amounts of time, energy, and money are devoted annually to the ultimate and proximate analyses of coal under national auspices, leaving the development of rational methods of examination and classification to individual effort. He believes that, if a fraction of the money spent on the older methods of analysis were devoted to a survey of coals by rational methods, an ideal classification would speedily result and our coal resources could be developed to the utmost advantage.

Declining Coal Output

The further extension of the use of gas to which the efforts of the Industry are being devoted should have no closer allies than the producers of coal, who are badly in need of a growth of demand for their raw material. The report of the Parliamentary Secretary to the Mines Department for 1932 indicates this in the statement that the output of coal was 4·9% less than in 1931, and 19·1% less than in 1929. It was, in fact, the lowest tonnage recorded during the past 34 years, except for 1921 and 1926, when output was affected by national stoppages. As a consequence of this condition of affairs, there was a further heavy reduction in the number of workers employed.

During 1932 shipments of British coal abroad, including foreign bunkers and the coal equivalent of coke and manufactured fuel exported, fell by 4½ million tons to a little over 57 million tons, which represents a decrease of more than 7%. There was no change in the average declared value of British coal exported, which remained at 16s. 3d. per ton, f.o.b. It is, however, remarked in the report that changes in the proportions of various qualities of coal and anthracite exported tend to obscure a downward movement in coal export prices generally, amounting on the average to 2%, chiefly affecting coal other than anthracite. The average number of wage-earners in employment in the British coal industry was 804,000 in 1932, or 48,000 fewer than in 1931, and 136,000 fewer than in 1929. On the average about twelve weeks were lost at the mines through want of trade in 1932.

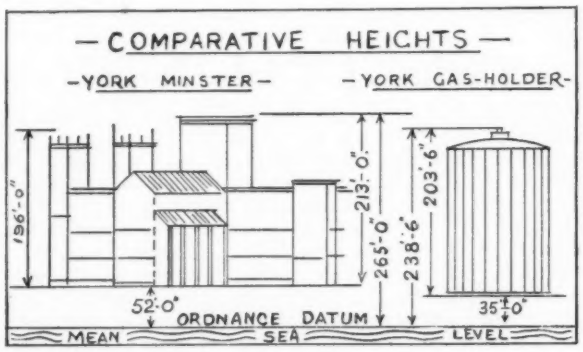
CORRESPONDENCE

York's New Gasholder.

SIR,—In view of the criticisms by the *Yorkshire Post* [see " JOURNAL " for Aug. 23, p. 410] regarding waterless gasholders and the statement that the York gasholder " puts everything out of scale," I thought it might be interesting to your readers to note the actual appearance of this gasholder in relation to the Minster as shown by the photographic view enclosed. This is taken from a building near York Station, and it is quite clear from this that the holder is not so high as the central tower of the Minster, and that it cannot therefore be regarded as disproportionate.

I also enclose a diagram which shows the comparative height and sizes of the Minster and of the gasholder. This demonstrates most clearly the true facts of the case.

YORK MINSTER AND THE NEW GASHOLDER.



No one can suggest that the presence of the holder in any way affects the view of the Minster, and it is a fact that from none of the well-known regular viewpoints is the sight of the Minster obstructed by the gasholder. Even from the point specially mentioned by the *Yorkshire Post*—the east—the view is dignified and impressive. It is true that the view which one street previously enjoyed is interrupted by the gasholder, but this has nothing to do with the type of erection, as it would be obstructed by whatever type of large structure was placed on this site. I believe it is nearly impossible to get a glimpse of the holder anywhere between the station and the Cathedral, or from the centre of the City.

Yours, &c.,
W. BESWICK,
Managing Director.

Ashmore, Benson, Pease, & Co., Ltd.,
Parkfield Works, Stockton-on-Tees,
Sept. 1, 1933.

Carburetted Water Gas.

SIR,—We are constantly hearing about methods of sales propaganda, and from time to time about distribution, and even storage, but it is so seldom that we have the opportunity of perusing such a valuable dissertation on a " manufacture " problem as that given in the treatise on " Carburetted Water Gas as a Coal Gas Auxiliary," recently published in the " JOURNAL " (Aug. 23 and Aug. 30), that it seems to the writer somewhat unfortunate that these articles should appear during the holiday month of August. One of the reasons of this letter is to call the attention of those who are reading the Technical Journals for them in their chiefs' absence, to the value of the treatise, and to advise them to see that the absentees have an opportunity of perusing it on their return to business. The argument will be of greatest interest to those responsible for the policy of methods of manufacture—namely, chief engineers and managing directors—but it could be studied with advantage by many members of Boards and Committees so that they may the better appreciate the difficulty of appraising intelligently the cost of manufacture, while those who have yet to " win their spurs " will find in its study a useful example of what can be attained by scientific control, as exemplified by what the authors call " Operating Strategy."

As one who has had to be in close touch for many years with figures of costs of manufacture and plant, I consider the figures used as being very fair. This is what one would expect from a firm of the standing of Messrs. Humphreys & Glasgow, and no doubt the various items in cost of manufacture have been supplied to them by some of their many friends, and are actual figures obtained in practice.

It is refreshing to see the case for adoption of water gas put forward again, as the novelty of the process having worn off since its introduction forty years ago, there must be many who do not recall the views of its advocates in those days and have not had the opportunity of personal acquaintance with its use. The question of the disposal of our coke, so much discussed at that time, is still with us, and although much has been done by careful preparation and grading to extend its sale, especially for domestic use, one learns that in many places large coke stocks are causing considerable anxiety. The comparative freedom from excessive coke stocks during the past decade or two has been very welcome to the Industry, but it can hardly be expected to continue indefinitely, and a return of better trade conditions and natural extension of the use of gas for domestic and trade purposes must inevitably increase the quantity of coke made. It must also be borne in mind that the cost of breaking and grading coke is considerable, and greatly reduces the return from coke, per ton of coal, in the accounts.

As the argument in Part I. develops, the whole question

of the use of water gas assumes a new interest, and the implied method of varying the quantity of coal gas made to suit not only the seasonal demand, but also to ensure the most economical working, and using water gas to make up what, for want of a better name, is called the "Peak Load Portion," immediately prompts consideration of many details by which economies can be effected. Altogether it is most interesting reading.

Many useful figures are gathered together in Part II., and the note on the thermal value obtained from a gallon of oil will be welcomed by many.

I trust I have not trespassed too much on your space, but the subject is such an important one for the Industry that I could not refrain from expressing my appreciation of the treatise, in the hope that this letter may induce some, who otherwise might not do so, to read, mark, learn, and inwardly digest it.

Yours, &c.,
JOHN TERRACE.

Dysart,
Lawrie Park Crescent,
Sydenham, S.E. 26,
Sept. 1, 1933.

PERSONAL

Mr. S. DAVIES, Retail Sales Manager, Chesterfield Corporation Gas Department, has been appointed Assistant Sales Superintendent to the Sheffield Gas Company, and will commence his duties on Oct. 2.

OBITUARY

SIR PHILIP MAGNUS, BART.

The recent death of Sir Philip Magnus, Bart., D.Sc., at his home, Tangley Hill, Chilworth, Surrey, recalls his association with the examinations of the City and Guilds of London Institute, during which period the late Mr. A. F. Browne acted as Examiner in Gas Engineering for some years.

Born in London, he reached the ripe age of ninety years. He was educated at University College School, and afterwards at the College itself, where he graduated with first-class honours in Arts and Sciences. Sir Philip was, in the year 1890, elected by his fellow-graduates to a seat on the Senate of the University of London. There he worked in the re-organization of the institution, so that when Sir Michael Foster vacated his seat as Member of Parliament for the University of London, Sir Philip was returned as a Unionist. This seat he held till 1923, when, having passed the age of eighty, he decided to retire from political life.

* * *

The death has occurred of Mr. W. C. KIMPSTER, Engineer and Manager to the Bishop's Stortford, Harlow, and Epping Gas and Electricity Company, after an operation while on holiday at Southwold.

THE NEWS OF THE WEEK

The All-Gas House that Jack Built is the title of a fascinating little rhyme and painting book just published by the British Commercial Gas Association. The well-known figure of Mr. Therm acts as guide on a tour of the house, showing in entertaining rhymes all the wonderful things he can accomplish, while accompanying him are many familiar characters from fiction and fairyland.

The Sir John Cass Technical Institute (Jewry Street, Aldgate, E.C. 3) announces a special lecture by Mr. E. V. Evans, O.B.E., F.I.C., on Thursday, Sept. 28, at 6.45 p.m. This lecture forms an introduction to the course on "Coal Carbonization" which has been held for some years at the Institute, but is open to the public, admission free, without ticket. We understand that Mr. Evans has selected "Gas Manufacture and the Applied Chemist" as his subject.

Price Reduction.—At the monthly meeting of the Gourock Town Council the price of gas was reduced by 4d. per 1000 c.ft., or 1d. per therm, to ordinary consumers, and 5d. per 1000 c.ft., or 1¼d. per therm, to prepayment consumers, making the new price 3s. 7d. per 1000 c.ft., or 10¼d. per therm, to ordinary consumers, and 4s. 2d. per 1000 c.ft., or 1s. 0½d. per therm, to prepayment consumers. The price of gas in Gourock has been reduced 40% during the past six years, and the new price is the lowest since 1918. The net profit on the year's working was £556. At the same meeting the rates also were reduced by 2d. in the £.

New Companies Registered.

The Stanley and District Gas Company has been registered as a public company with a capital of £70,000 in £1 shares. The object is to acquire the business carried on as the Stanley and District Gas Company.

Another new concern is the Koela Producer-Gas Plant Company, a private company with a capital of £15,000 in 14,500 £1 shares and 10,000 1s. ordinary.

Annual Conference of the B.C.G.A.

The following programme has been arranged for the Annual Conference of the British Commercial Gas Association, to be held in Bournemouth under the Presidency of Mr. William Cash:

Monday, Sept. 25.

8.30 p.m. Reception of Conference Delegates by the Mayor and Corporation of Bournemouth in the Town Hall, followed by a Dance.

Tuesday, Sept. 26.

MORNING (THE PAVILION).

10. 0 a.m. Annual General Meeting.
Presentation of Annual Report and Accounts.
Presidential Address by Mr. William Cash, J.P., F.C.A. (President of the Association).

AFTERNOON (THE PAVILION).

3. 0 p.m. Paper by Mr. A. P. Ryan (Publicity Manager of the Gas Light and Coke Company, London), on "Publicity," followed by Discussion.

EVENING (THE PAVILION).

7. 0 p.m. for 7.30 p.m. Annual Dinner to the Delegates, who will be the guests of the Chairman and Directors of the Bournemouth Gas and Water Company.

Wednesday, Sept. 27.

MORNING (THE PAVILION).

10. 0 a.m. Paper by Mr. H. D. Madden, M.Inst.C.E. (Chief Engineer and Manager of the Cardiff Gas Light and Coke Company), entitled "Defence and Development of Our Business in Cardiff," followed by Discussion.
Luncheon by President and Members of the Association to the retiring President and the Directors of the Bournemouth Gas and Water Company.

AFTERNOON.

2. 0 p.m. Visit to the Pitwines Gas-Works.

THE NEWS—continued.

Trade Revival and the B.I.F.

The confidence which many well-informed observers are expressing in the outlook for British industry is given distinct encouragement by the latest reports upon preparations now in hand for the 1934 British Industries Fair.

Although the Fair does not open until Feb. 19, the Department of Overseas Trade reports that it has already received applications for more than 90% of the space occupied by exhibitors at Olympia and in the Furniture Section at the White City at the last Fair.

In the "heavy industries" section, at Birmingham, advance bookings of space by exhibitors are so far ahead of those last year, or indeed, in any previous year, that some 55,000 sq. ft. of indoor area is being added immediately to meet pressing demands. Especial activity is reported in the gas, electricity, building, and engineering groups.

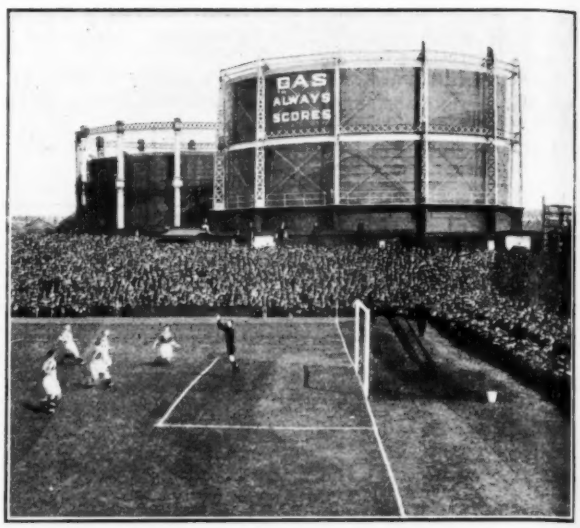
New Type of Gas Boiler.

A recently introduced high-efficiency vertical boiler fired by town gas is known as the "Sinuflo," and is manufactured by Messrs. P. Kirke & Co., 35, Walpole Street, London, S.W. 3.

The great advance in efficiency obtained in these "Sinuflo" boilers is due to the discovery of the inventor that it is possible to accelerate the transmission of heat in firetubes 150% or more without the use of retarders and without reducing the sectional area through the tubes. It is claimed that this discovery, which is fully protected by patents throughout the world, enables the same drop in temperature to be obtained in a tube of given length as can be obtained in an ordinary firetube 2½ times as long. This remarkable result is obtained by forming the tubes with a large number of very short contiguous arcs, the direction of curvature of adjacent arcs being reversed. As it is possible to pass a thick straight rod through the tubes, they are easily cleaned either with a long fibre brush or with a short steel brush.

The boilers may be constructed for any working pressure, the standard being 120 lbs. per sq. in.

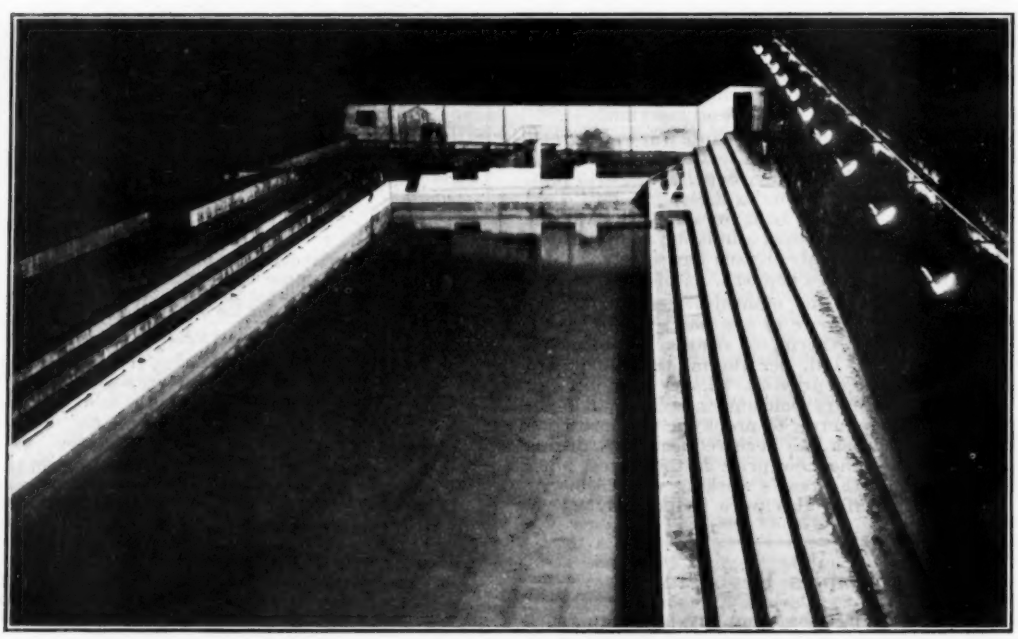
"Gas Always Scores."



[*Photo. by the Staffordshire Sentinel.*

Reference was made in the "JOURNAL" last week to the slogan on the Stoke-on-Trent Corporation's gasholder adjacent to the football ground of the local team, now in the First Division. Mr. A. Mackay, the Chief Engineer and General Manager of the City of Stoke Gas Department, now sends us a photograph of the holder, here reproduced. This form of advertising has created a great deal of interest in the city—so much so that the local Press has applied for space on the holder for advertising purposes.

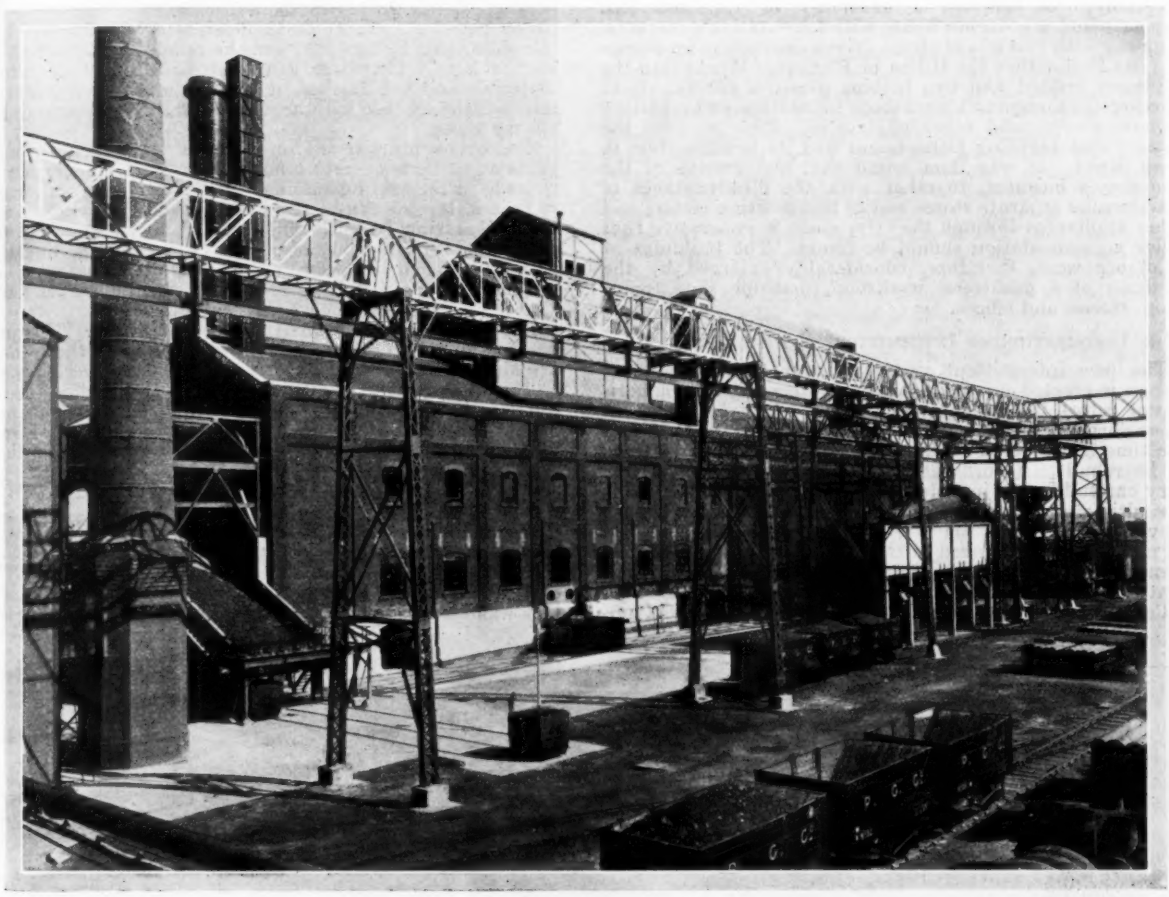
Another Floodlighting Success



The City of Plymouth Gas Department is floodlighting Mount Wise Baths, Devonport, with gas; and this photograph, kindly sent by Mr. F. Blackburn, the Engineer and General Manager, was taken at twelve midnight. A further proof of the efficacy of gas for this purpose.

PORTSMOUTH'S NEW CARBONIZING PLANT

Inauguration of Intermittent Vertical Chamber Ovens at the Hilsea Works



EXTERIOR VIEW OF RECONSTRUCTED RETORT HOUSE, HILSEA.

On Monday last the Lord Mayor of Portsmouth, Alderman W. A. Billing, J.P., inaugurated new carbonizing plant, consisting of a setting of Woodall-Duckham intermittent chamber ovens, at the Hilsea Works of the Portsmouth Gas Company. The following is a description of the plant taken from a brochure prepared for the occasion. Our report of the opening proceedings is published at the end of this description.

The Portsea Island Gas Company (now the Portsmouth Gas Company) was incorporated by Act of Parliament in May, 1821.

Fourteen Acts and Special Orders to increase the scope of the Company have been obtained since then. The Special Orders granted by the Board of Trade in 1926 and 1927 authorized the transfer to the Company of the Havant Gas Company and the Emsworth Gas Company, respectively. This increased the statutory area of supply from 20 to 103 sq. miles, and it now includes, in addition to the City of Portsmouth, the districts of Cowplain, Denmead, Emsworth, Havant, Horndean, Portchester, Purbrook, Rowlands Castle, Westbourne, and Waterlooville.

The output of the Company has rapidly increased, and in the last forty years the rate of expansion has been remarkable. The number of consumers has increased nearly sevenfold, and the quantity of gas made is more than four times as great, as will be seen from the following:

Year.		C.Ft. of Gas Made.		No. of Consumers.
1895	..	699,530,000	..	10,600
1932	..	2,844,991,000	..	71,340

The number of prepayment consumers has increased at a greater rate than the ordinary consumers, and at the end of 1932 there were 42,382 of the former and 28,958 of the latter.

The present price of gas to ordinary consumers within the City of Portsmouth is 7d. per therm, or 2s. 7½d. per 1000 c.ft. Prepayment consumers pay 8d. per therm where the meter only is supplied, and 8·3d. per therm where meter and fittings are supplied. A scale of discounts is allowed, ranging up to a maximum of 15%, and this has been the means of increasing the use of gas for industrial and central heating purposes.

To-day the issued capital stands at £1,080,740, of which £745,862 is ordinary stock, £323,500 loan capital, and £11,378 premium capital after deduction of discount on redeemable debenture stock. The number of stockholders is about 1200.

The Chief Offices and Showrooms occupy an important position in The Square, and were built in 1914 to replace a building erected on the same site in 1877.

As evidence of the progress and development of the Company, despite the displacement of labour caused through the increasing adoption of mechanized methods, the number of persons employed is now 936 compared with 686 in 1921, in which year the Company celebrated its centenary of incorporation.

The Company's Works.

The Company owns three works, two of which are chiefly concerned with manufacture, and the other devoted to distribution. The oldest is Flathouse, which was built in 1834 and occupies an area of a little over three acres between H.M. Dockyard and Flathouse Wharf. It uses

entirely seaborne coal from the Durham mines. The carbonizing plant consists of "C.O.L." intermittent vertical chambers, settings of horizontal retorts, and, in addition, two complete units for production of water gas.

Hilsea Works was built in 1905, extended in 1920, and covers an area of 32 acres. In contradistinction to Flathouse, it adjoins a main railway line and is amply provided with sidings. The carbonizing plant consists of two benches of continuous vertical retorts, ten settings of horizontal retorts, three complete units of water gas apparatus, and the new installation of intermittent vertical chambers.

Rudmore Works is the main distributing centre of the Company. It contains a gasholder of 1,579,000 c.ft. capacity and a governor house with four station governors, together with two sets of steam driven exhausters for pumping gas from either the Hilsea or Flathouse Works into the Rudmore holder, and two turbine pressure raisers. Here also are the Company's workshops for testing and repairing meters, stoves, and other appliances. Prior to 1926 the Fitting and Lighting Department had its headquarters in Park Road. It was then found that the growth of the Company's business, together with the disadvantages of maintaining separate stores and of transporting meters and other appliances through the city, made it imperative that other accommodation should be found. The buildings at Rudmore were, therefore, considerably enlarged by the addition of a gasfitters' workshop, machine shop, paint shop, stores, and offices.

The Installation of Intermittent Vertical Chambers.

The new intermittent vertical chamber oven plant at Hilsea is erected on a site previously occupied by a horizontal retort bench. This old plant, which had been in operation over twenty years, had given good service, and the time had arrived for the major portion of the settings to be rebuilt. Accordingly, the question of renewal was very carefully gone into during the autumn of 1931, and it was ultimately decided that the reconstructed plant should be vertical retorts of the "W.D." intermittent type. The Directors were influenced in their decision by the fact that transport of seaborne coal is considerably cheaper than that of railborne coal.

Coal is transported from Durham by sea to the Company's Flathouse Wharf, where it is unloaded and conveyed in Foden wagons by road to the Hilsea Railway Coal Dock. Afted adding the transport and handling charges involved, the cost of seaborne coal at Hilsea is considerably cheaper than railborne coal.

The installation comprises 35 chambers arranged in one bench of 5 settings, each containing 7 chambers, a producer, recuperator, and waste gas flue. The settings are entirely independent, a partition wall and straight joints separating each.

There are also provided a complete coal and coke handling plant, with overhead coal, coke, and breeze storage hoppers, and a waste-heat boiler.

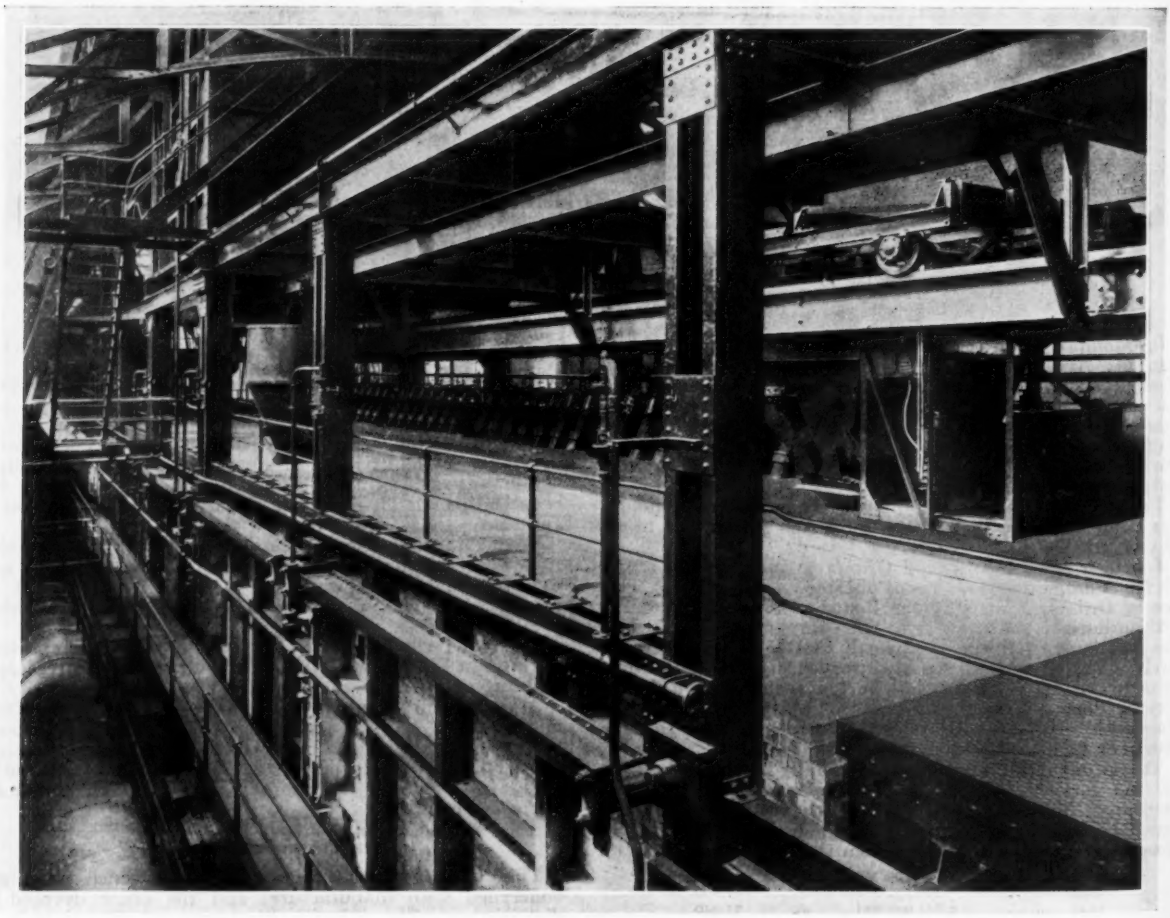
The chambers are 21 ft. in height, rectangular in plan, the major axis being 10 ft. and the minor axis about 12 in. at the base. They are constructed in silica refractory materials and are finished at the top with fireclay blocks, into which are bedded the coal charging doors and gas offtake pipes.

The ovens are carried on castings supported by steel joists at 10 ft. from retort house floor level, and provision is made in the seating castings for the admission of steam, so that water gas can be produced during the last hours of the carbonizing period. They are normally charged and discharged at intervals of about twelve hours, but this period can be varied according to the class of coal used and the thermal quality of gas required. Each chamber has a capacity of 3·5 tons of coal per charge.

The chambers are heated by producer gas. The producers and also the recuperators which preheat the secondary air required for the combustion of the producer gas are built into the settings and rise from the ground floor to the full height of the bench, approximately 32 ft. The producers are fitted with step grates of ample area to give a uniform and steady supply of gas to the combustion flues, situated between the chambers.

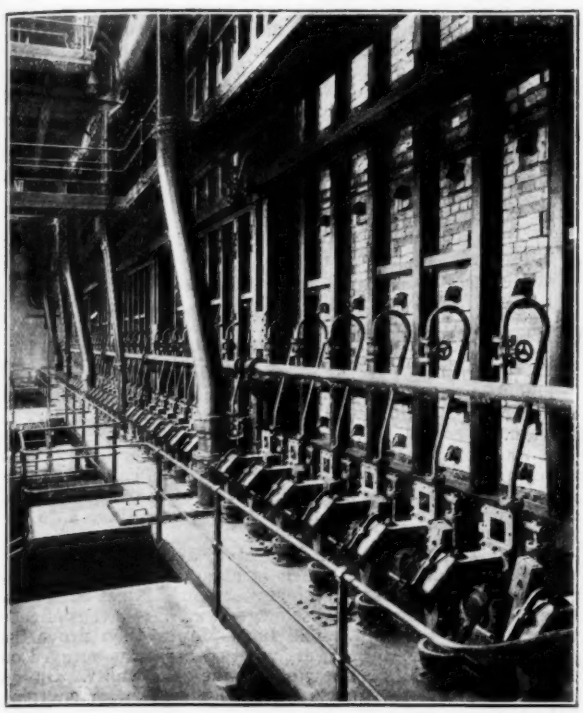
Coal and Coke Handling Plant.

The main part of the coal and coke handling plant is erected in the coal store adjacent to the chamber house, and is designed to handle 75 tons of coal per hour. The coal, as delivered, is discharged from the Company's railway wagons into a twin receiving hopper arranged beneath



TOP OF BENCH SHOWING COAL CHARGING CAR ON EXTREME RIGHT WITH GAS OFFTAKES IN THE BACKGROUND.

one of the overhead rail tracks in the existing coal store. At each bottom outlet of the hopper a drag bar conveyor feeds the coal into single roll breakers which, in turn, discharge into a small receiving hopper situated beneath the breakers. From this hopper, the broken coal is delivered by band conveyor to an auxiliary feeding hopper arranged on the opposite side of the coal store, from which it is automatically passed into a twin skip hoist, then elevated and deposited into the overhead storage bunkers, a shuttle



Bottom Gas Offtakes, Gas Collecting Mains, and Steam Supply to the Chambers.

band conveyor being used to distribute the coal to any part of the bunkers.

In order that the complete charge of coal in the chambers can be carbonized, it is necessary to fill the bottom portions of these with coke breeze. The breeze required for this purpose and the coke for the producers are brought in railway wagons to the auxiliary feeding hopper, elevated by means of the skip hoist and carried by the shuttle band conveyor into compartments which are adjacent to and form an extension of the overhead coal storage bunkers. The coke for the producers is then taken by an overhead mono-rail skip and charged into the furnaces as required.

The chambers are charged by a combined coal and breeze car, which is divided into two compartments, these being filled with coal and breeze obtained from the overhead storage bunkers. The car discharges the coal and breeze into the chambers, and is designed to preclude the possibility of any coal entering the chambers before the breeze has been dropped. After charging, three self-sealing lids close the oven and make it gas-tight.

Each chamber is fitted at the bottom with a gas-tight door which is opened and closed by hydraulic power, and, after carbonization and steaming of the charge, the hot coke is dropped by gravity from the chamber immediately the bottom door is released. The hot coke falls into a "coke bus" which is propelled by a locomotive running on rails laid on the floor beneath the chambers, until it reaches the quenching tower situated at the northern end of the retort bench. The quenching of the coke is effected by water from an overhead steel service tank of 900 gallons capacity, through sprays placed at the base of the tower, which is a steel framed structure lined with matchboarding, 120 ft. in height.

The "coke bus" is then lifted from its chassis by a 7½-ton overhead crane, and transported to a position above the elevated coke wharf, where the bus is discharged of its contents. Finally, the coke is dropped from the wharf into steel telpher skips and conveyed to the cutting and grading plant.

Each chamber is fitted with a cast-iron top gas offtake pipe leading into a steel collecting main running along one side of the bench. The offtakes, which are provided with liquor sprays and special valves, are kept sealed during the period occupied in discharging and recharging the chambers with coal. The chambers are also equipped with bottom gas offtakes and collecting mains, which prevent the development of excessive pressures in the lower parts of the ovens. The liquor in circulation, and any tar which is deposited in the top collecting main, are taken through downtakes into the bottom collecting main and thence to a liquor and tar separating system.

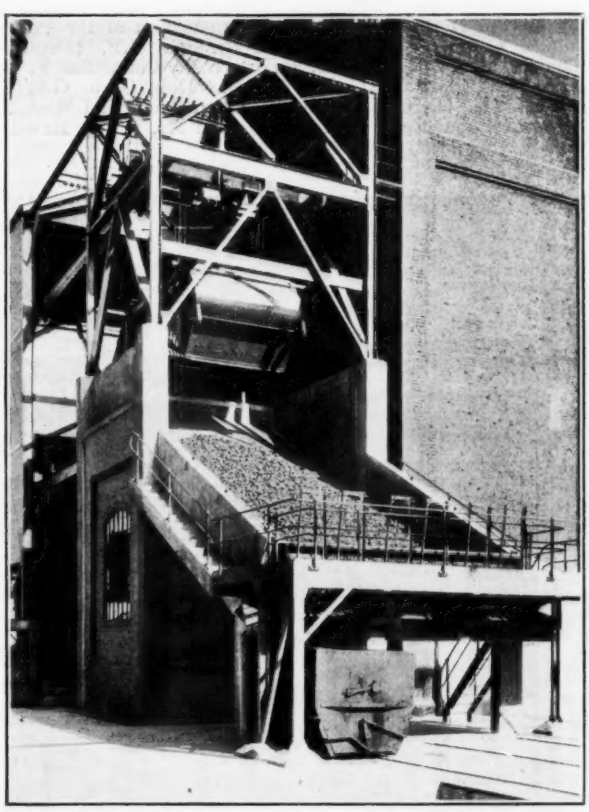
The gas from the collecting mains passes through an "Arca" regulator into the foul gas main, and from there direct to the condensing and purifying plant.

Waste Heat Recovery.

As the whole installation is designed to reduce to a minimum the fuel consumption required for the carbonization of the coal, the front and top of the settings and all live steam piping have been adequately lagged with an efficient non-conducting material. Further, the waste gases, after heating the chambers, are passed through the recuperators and then taken through a circular steel main to the waste-heat boiler, which is of the horizontal fire-tube induced draught type, capable of producing 8000 lbs. of steam per hour from the sensible heat of the waste gases before these are finally discharged to the atmosphere through the steel chimney. This steam from the waste-heat boiler is adequate for the full working of the installation, including the steaming of the charges.

Special attention has been given to the efficient working of the plant, and, therefore, all pumps, meters, gauges, instruments, and the waste-heat boiler are housed in one building, from which the general condition and working of the installation can be observed. A second smaller instrument panel is also fitted at the top of the setting level for the guidance of the bench operators.

Access to all sections of the installation has been designed for the purpose of easy inspection and control, and ample stairways and gangways are provided. A 30-cwt.



Transporter Crane and Elevated Coke Wharf.

lift is arranged for taking passengers and goods to the various working platform levels, the highest platform being 75 ft. above the ground floor of the retort house.

Coke Cutting and Grading Plant.

The coke cutting and grading plant has a nominal capacity of 20 tons per hour, is flexible in operation, and capable of meeting the varying demands for different grades of coke required for industrial and domestic purposes. The coke is conveyed by the telpher machine from

the wharf to the receiving hopper of the cutting plant and, from there, is discharged by a mechanical feeder of the draw-plate type, to the cutting machine or the by-pass chute. This crushing plant is capable of being set to cut coke to 2½ in. size and under, and is provided with an adjustable device for varying the size of coke.

All breeze below ⅜ in. is removed by a vibratory screen, and the de-breezed coke is then taken by an inclined band conveyor to a totally enclosed rotary screen, where the coke is graded and each size deposited into separate compartments of the hoppers. At the outlet of these hoppers are fitted secondary de-breezing screens of the balanced reciprocating type, which remove any breeze caused by storage and ensure that the final coke product will meet the most exacting requirements.

Capable of handling 30 tons per hour, the de-breezing screens load the coke into a buffer hopper of 2 cwt. capacity, situated directly above "Belle Isle" weighing machines for rapid discharge into bags according to consumers' requirements.

The two most popular grades are: Domestic coke, No. 3—size ⅜ in. by 1¼ in. (suitable for hot water boilers, coke fires, &c.); large coke, No. 2—size 1¼ in. by 2¼ in. (suitable for furnace, boiler, and other industrial work).

General.

The Hilsea Works, as now remodelled and extended, has a nominal maximum daily production of 7 million c.ft. of coal gas and 3,750,000 c.ft. of water gas, a total of 10,750,000 c.ft. (48,000 therms) per day, and has a storage accommodation of 5 million c.ft.

The older Works at Flathouse, which has been modernized from time to time, has a daily manufacturing capacity of 2,750,000 c.ft. of coal gas, and 1,250,000 c.ft. of water gas, which when added to the production of Hilsea makes a total of 14,750,000 c.ft. (66,000 therms) per day. The storage accommodation at Flathouse is 3 million c.ft., making with that of Hilsea a total of 8 millions.

The record sale of gas in one day has been 11 millions and the largest week's sale 75 millions.

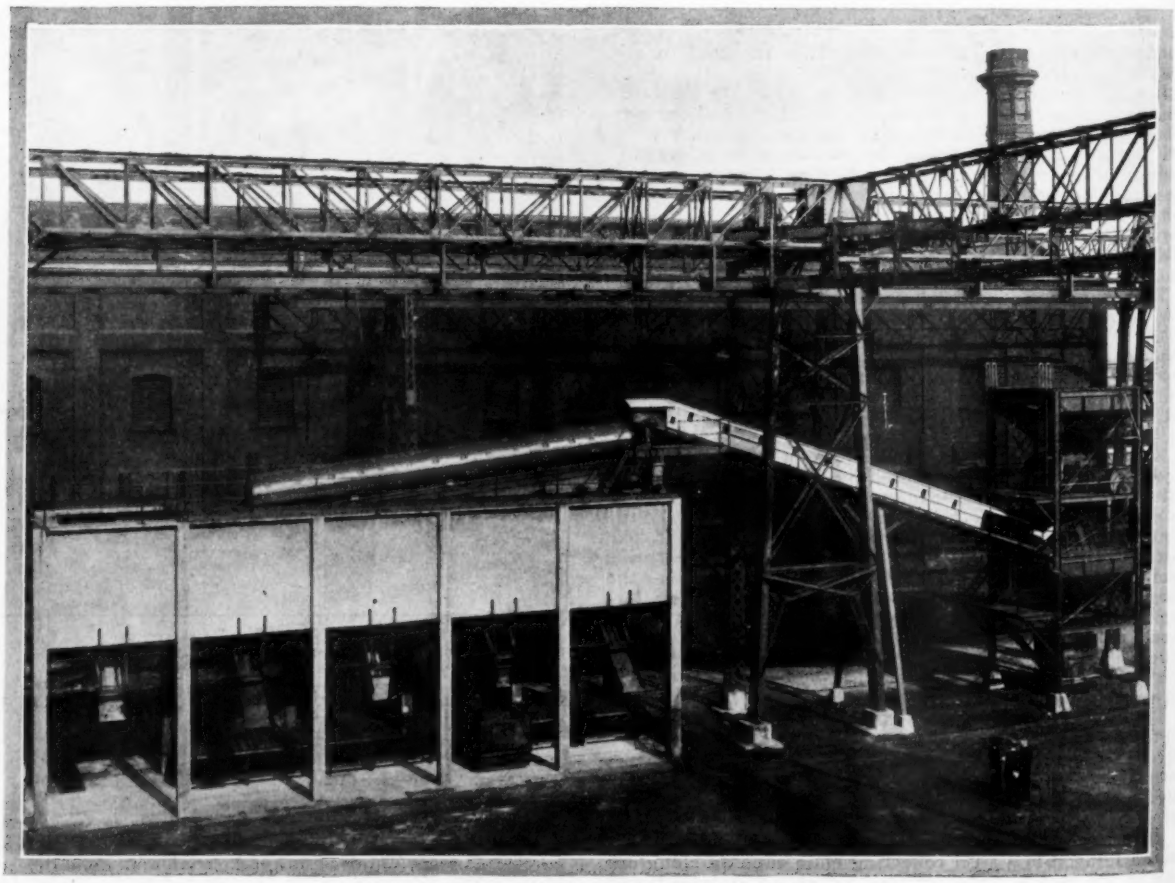
The Inauguration Ceremony

The plant was inaugurated by the Lord Mayor of Portsmouth (Alderman W. A. Billing) in the presence of Directors and Officials of the Company, representatives of the Staff and Welfare Committee, and many prominent public men. Among those present were Lord Hyndley, Sir Russell Bencraft, J.P., Sir Harold Pink, J.P., Alderman F. G. Foster, J.P., Messrs. C. Valon Bennett (Senior Vice-President of the Institution of Gas Engineers), and F. B. Richards, M.B.E. (Chairman of the Contracting Firm, the Woodall-Duckham Company). The guests were welcomed by Mr. T. H. F. Lapthorn, J.P. (Chairman of the Portsmouth Company), Mr. William Gillman, J.P. (Deputy-Chairman), Capt. R. J. E. Baker, B.A., Councillor F. E. Beddow, D.Sc., Ph.D., Mr. William Doig Gibb, O.B.E., M.Inst.C.E. (Directors), Mr. T. Carmichael, M.I.Mech.E. (Engineer and General Manager), and Mr. R. W. Hewitt, A.C.A. (Secretary).

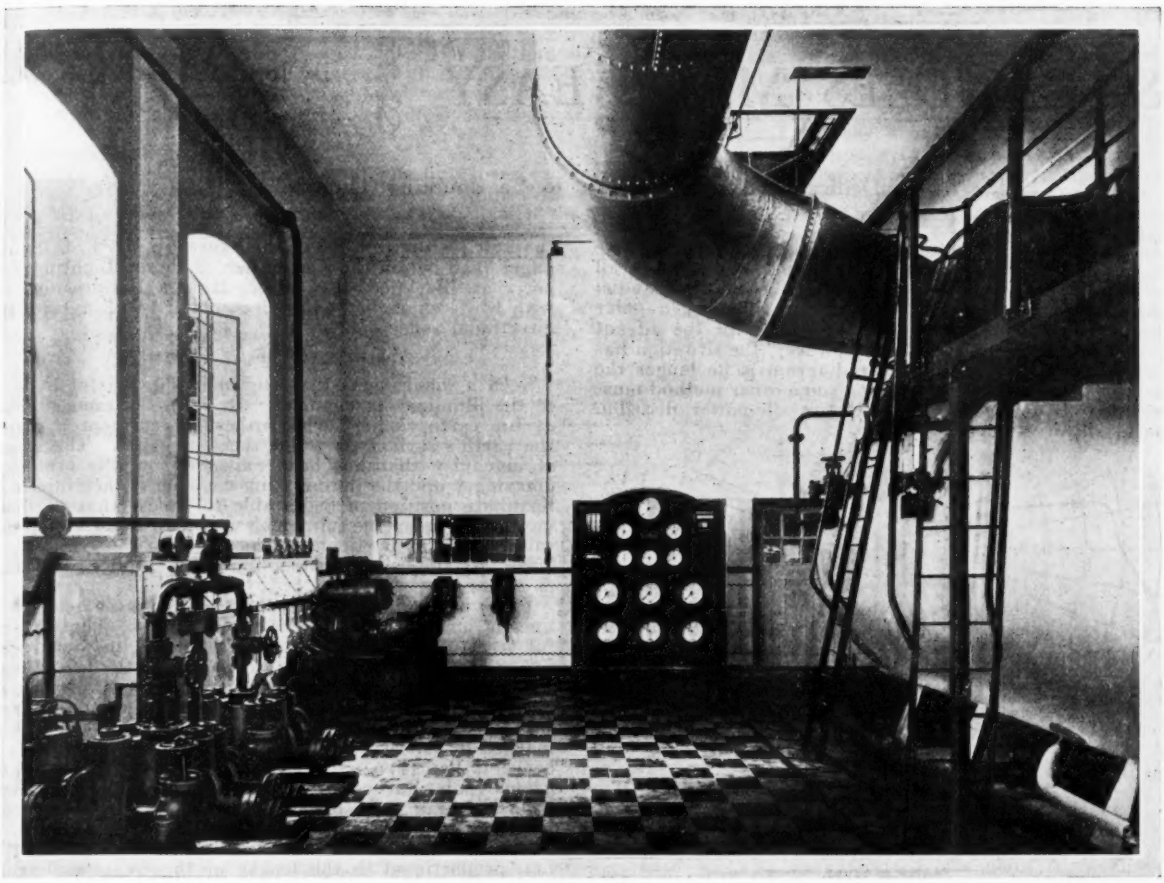
The first part of the ceremony took place in the new boiler house, where the Lord Mayor set the machinery in motion.

It was explained by Mr. Carmichael that the boiler which the Lord Mayor had put into operation was capable of producing 8000 lbs. of steam per hour from the sensible heat of the waste gases before finally discharging them into the atmosphere.

The new plant was then inspected, and the Lord Mayor entered the locomotive which is attached to the hot coal skip and drove the skip underneath the vertical chambers. One of the chambers was discharged and over 3 tons of coke dropped into the skip. The Lord Mayor then drove the skip to the quenching tower, where water was sprayed on the coke prior to its conveyance to the coke wharf. On top of the chambers the guests watched the chamber charging car carry out its work of refilling with 3½ tons of coal the



COKE BUNKERS, CUTTING AND GRADING PLANT.



INTERIOR OF POWER HOUSE SHOWING PUMPS, INSTRUMENT PANELS, AND, ON THE RIGHT, WASTE HEAT BOILER.

chamber that had been emptied. Other departments of the works were also inspected.

Lunch was afterwards served in the dining-room at the works, and in proposing the toast of "Our Guests,"

The CHAIRMAN, Mr. Lapthorn, J.P., said that they had to thank the contractors, the Woodall-Duckham Company, for a fine piece of workmanship, and although the guarantee tests had not yet been made, the Gas Company's Engineer and General Manager, Mr. Carmichael, felt quite sure about the result. He had one tinge of regret, and that was that the head of the firm at the time the contract was placed, Sir Arthur Duckham, was not spared to see the work carried through. His death was a great loss not only to the Gas Industry, but to the country as a whole, because a great deal of his life was spent in unpaid service of a distinguished character. He would like to say that they had also installed a coke cutting and grading plant at considerable expense, and if people in their area would confine their purchases to coke they would get a first-class article and would also help the labour market and indirectly the local rates. Tar, another of their important bye-products, was one which at times gave them some anxiety, because many of their road authorities, he was sorry to say, still imported bitumen, a foreign article, in preference to using the home-made product. He was assured by those who used tar that it was in every way equal to bitumen for road surfacing, and he hoped that if any of the guests had any influence in the matter they would endeavour to see that the home produced article was used instead of the foreign product. Although the work at Hilsea was now practically finished, they were still doing what they could to relieve the unemployment situation, because they were erecting a new holder at Emsworth. That work was now in hand and would find employment for a number of men for some little time. In all their works, Mr. Lapthorn added, they were fortunate in having a contented and loyal staff, and the relations existing between them continued to be of the very best.

THREE FINE RECORDS.

The LORD MAYOR OF PORTSMOUTH, in responding to the toast, commented on the fact that last year the Company made three new records—in the sale of gas, in the increased number of customers, and in the issue of appliances—and said that when they remembered that they were passing through a period of great depression, with a tremendous amount of unemployment, the creation of those new records spoke volumes for the management of the concern. Despite all the wonderful improvements they had seen at those works in the way of labour saving and in the manner the materials were handled, it was a remarkable fact that since 1921 the Company had increased their employees by something like 40%. He thought he was only right in saying that a great deal of the success of the Undertaking had been brought about by the methods introduced by their Engineer, Mr. Carmichael, and their Chairman, Mr. Lapthorn, who had been a Director for 25 years.

Mr. C. VALON BENNETT, Vice-President of the Institution of Gas Engineers, who also responded, said he had visited the works both at Hilsea and at Flathouse on many occasions, and had always been impressed by the efforts made to ensure that only the most modern gas-making plant should be employed. The plant they had seen that morning was among the most up-to-date in the country. In these days they heard a lot about economy, but he considered that this installation was a wise economy, because it was wise spending. During the last 15 years the Company's sales of gas had increased from 1547 million c.ft. to 2708 millions, which was equal to no less than 75%. During the same period the number of consumers had increased from 51,500 to 71,900, equal to about 40%. That proved that the Company's consumers knew they were getting a square deal, and that they appreciated that gas was the cheapest form of lighting, cooking, and heating. Mr. Bennett added that they might wonder why he had chosen the period of 15 years, but that happened to be the period that Mr. Carmichael had been the Engineer and General Manager of the Company. Mr. Carmichael had proved himself an Engineer of exceptional ability, and he was a man for whom they in the Gas Industry had the highest regard.

At this stage, the CHAIRMAN asked the Lord Mayor's acceptance of a handsome silver cigar box as a memento of the occasion, and Alderman BILLING, in acknowledging the gift, said he regarded it as a token of the happy relationship existing between the Company and the civic authorities.

A STORY OF CONTINUOUS PROGRESS.

Mr. F. B. RICHARDS, M.B.E., Chairman of the Woodall-Duckham Company, afterwards gave the toast of the Portsmouth Gas Company, which, he mentioned, was founded as the Portsea Island Gas Company in 1821, so that it had reached a respectable age; but it still preserved all the energy and vitality of youth. The history of the Company had been one of continued progress from small beginnings to great achievements, and he wished it every success and prosperity in the future.

Lord HYNDLEY, on behalf of the guests, also added his good wishes, remarking that they were all agreed that the Company was one of the most efficient in the country.

Mr. LAPTHORN briefly replied, and Mr. CARMICHAEL also returned thanks for the references to himself. He added that he would like to compliment the contractors on the excellent job they had given them.

Later in the afternoon, an inspection of the new plant and works was carried out by the stockholders residing in the district, and they were afterwards entertained at tea.

ISO-CANDLES MADE EASY

By John W. T. Walsh, M.A., D.Sc.

Dedicated, in all humility, to "a doubting Thomas."*

In the case of a symmetrical lighting fitting—*i.e.*, one for which the candle-power distribution is the same in all vertical planes, complete information as to the candle-power in all directions in space is provided by a polar diagram such as that shown in fig. 1. With the advent of the modern asymmetric unit, however, the situation has changed completely. The polar diagram is no longer the same for every vertical plane, and some other method must therefore be devised to show the candle-power distribution in all directions in space.

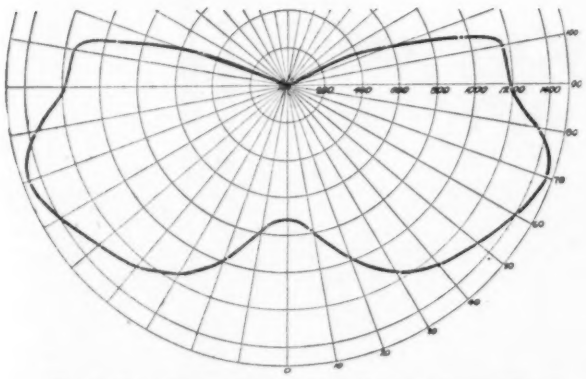


Fig. 1.—Polar Curve of Light Distribution for a Symmetrical Source of Light.

The diagram used for this purpose is known as the iso-candle diagram——

LECTOR: Pray tell me, dear Auctor, what is the meaning of the word iso-candle?

AUCTOR: Surely you have heard of "iso-bars," lines of equal atmospheric pressure, and "iso-therms," lines of equal temperature. Well, iso-candles are lines of equal candle-power. Pray do not interrupt with such elementary questions.

LECTOR (quite unrepentant): But iso-bars and iso-therms are plotted by meteorologists on maps of the world, and all the places which happen to be situated on any one iso-therm have the same temperature at the particular time of year for which the map is drawn. I cannot see any connection between a map of the world showing iso-therms and an iso-candle diagram showing the candle-power distribution from a street-lighting unit.

AUCTOR (sweetly): That, dear Lector, is because you do not use your imagination sufficiently. Do you not remember those globes from which we used to learn geography at school? Try to imagine one of them magnified, say, one hundred times and made of glass, but still marked with the lines of latitude and longitude we thought so meaningless. Put your street-lighting unit at the centre of this sphere and you will have taken the first step towards constructing an iso-candle diagram.

Let us now suppose that a large number of Lilliputian observers, distributed all over the globe, decide to measure the candle-power of this great luminary which is shining so brilliantly beneath their feet. Clearly, it will be quite possible to draw lines on the sphere so that each line passes through all those places on the globe where the candle-power is found to be the same. One line, for instance, will pass through all those places at which the candle-power is found to be 500, another line will pass through all the places where it is 750, and so on.

I think now you will see quite clearly, dear Lector, that there is no more difficulty in understanding the meaning of an iso-candle diagram obtained in this way than there is in following the meteorologist when he presents you with a map covered with iso-therms. For example, the appearance of the globe when such a diagram has been plotted on it is shown in fig. 2. This diagram refers to the unit pictured in one of the figures in Mr. F. C. Smith's paper read before the Association of Public Lighting Engineers at Blackpool last year. It is a low-pressure unit with white enamelled top reflector and two Staybrite steel directional reflectors.

MAKING A "FLAT EARTH."

Such a diagram as that shown in fig. 2 is of little use to the illuminating engineer. He is in the same difficulty as the cartographer* who wishes to represent a map of the earth's surface on a flat sheet of paper. The amount of ingenuity that has been expended on this problem is amazing,† and the illuminating engineer is therefore in the fortunate position of being able to choose that particular method of doing the job which appeals to him as the most suitable for his particular purpose.

He sets about the construction of his "flat earth," then, as follows:

First, he reminds himself that the distances between the lines of longitude on a globe are all equal. That is a useful start, so he draws nineteen parallel lines at regular intervals on a piece of paper as shown at the left of fig. 3. The middle line represents the equator and the top and bottom lines should really be points because they represent the North and South poles, respectively. The lines are marked 0, 10, 20, &c., from the bottom pole upwards because it has been agreed that for light distribution diagrams (polar curves included) all angles shall be measured from the nadir‡ (as 0°) to the zenith (as 180°) instead of from the equator upwards and downwards as in maps.

The next step is to make each line of the right length—*i.e.*, proportional to the length of the corresponding line of latitude. The length of the equator is, of course, double the distance between the poles, but if the diagram is to represent only one hemisphere the length of the middle line must be *equal* to the distance between the poles, and this is how it is drawn in fig. 3. It now remains to find the lengths of the other lines. This can be done graphically by drawing a circle on a diameter equal to the length of the middle line, as shown at the right of fig. 3. The method can be explained by choosing an example, say the

Fig. 2.—Spherical Surface with Iso-Candle Lines.

* At the conference of the Association of Public Lighting Engineers held last September, some doubts were expressed by Dr. J. S. G. Thomas as to the extent to which the iso-candle diagram was understood by illuminating engineers. (See "GAS JOURNAL," Vol. 199, p. 641, Sept. 21, 1932.)

* "Cartography—see Map," Encyclopædia Britannica Index.

† There is a long article about it, headed "Map Projections," in the current edition of the Encyclopædia Britannica, and whole books have been written about it.

‡ "The point of the heavens diametrically opposite to the zenith." Shorter Oxford English Dictionary.

50° line. OP is drawn at an angle of 50° with ON and then PQ is drawn perpendicular to ON and is produced to cut the circle again at R. The length PR is the length of the line marked 50 and the lengths of all the other lines may be found in exactly the same way. When this has been done the outline of the diagram takes that peculiar form——

LECTOR: Ha! the Onion!

AUCTOR (severely): I perceive that you have been reading one of those flippant expositions of the subject that have lately made their appearance in the Technical Press. Be so good as to remember that this is a serious matter, and try to follow me while I explain that the outline of this diagram is a sine-curve.

LECTOR (chastened): I feel that I shall follow the explanation more readily if you will be so good as to tell me what you mean by the word "sine."

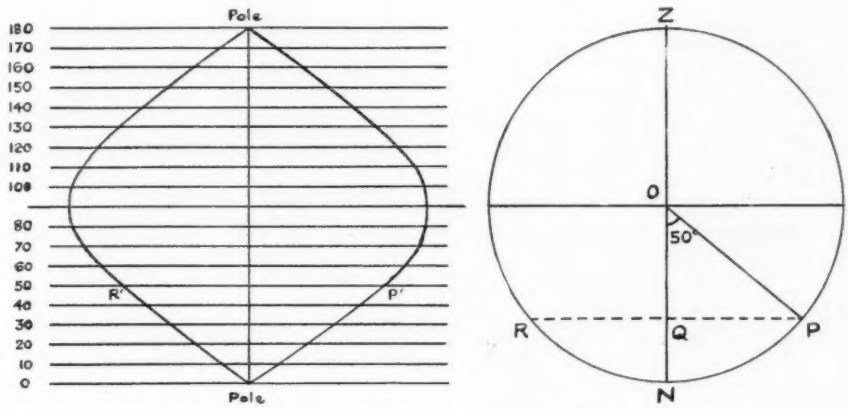


FIG. 3.—THE CONSTRUCTION OF THE ISO-CANDLE DIAGRAM.

AUCTOR: Take any right-angled triangle such, for instance, as the triangle OPQ in fig. 3. Then the sine of the angle POQ is defined by the mathematicians as the ratio of the side opposite that angle (*i.e.*, PQ) to the side opposite the right-angle (*i.e.*, OP). This fact is written as follows: —

$$\sin \mathrm{POQ} = \mathrm{PQ/OP},$$

the word "sine" being abbreviated to "sin." Now you will notice that OP is half the diameter of the circle—*i.e.*, it is half the length of the middle line of the diagram. It follows that if the length of this middle line be taken as unity, the length of the line P'R', which we have made equal to twice PQ, is equal to sin POQ—*i.e.*, to sin 50°. Similarly the length of every horizontal line is equal (on this scale) to the sine of the angle marked on it.

Now, dear Lector, you can understand why I described the outline of the diagram as a "sine-curve." There is really no need to draw the circle and measure the various lengths, because any book of mathematical tables will give you a "Table of Natural Sines" where you will find at once the sine of any angle. You only have to multiply the length of the middle line by the value given in the table for the angle in which you are interested, and there you will have at once the length of the corresponding line on the diagram.

The length of each such line is proportional to the length of the corresponding line of latitude on the sphere. This will be clear if it is remembered that a line of longitude is, in reality, a circle having as its radius the perpendicular drawn from any point on it to the line joining the poles of the sphere. The length of this perpendicular, expressed as a fraction of the radius of the sphere, is equal to the sine of the angle of the line of latitude *measured from the pole*. Naturally this ratio becomes unity at the equator, for then the perpendicular becomes identical with a radius of the sphere. Equally clearly, sin 90° = 1.

The third step necessary in order to complete the diagram is to divide each of the horizontal lines into eighteen equal parts and to join the corresponding points of partition, thus obtaining the intermediate lines of longitude. The final result is the network shown in fig. 4. It is now an easy matter to plot iso-candle lines on this network, and the result, if we take again the lighting unit which we chose for fig. 2, is shown in fig. 5.

LECTOR: I think I have followed your description so far, and I agree that the onion—I mean the sinusoidal diagram—does represent the surface of a hemisphere with its lines of latitude and longitude. What I cannot understand, however, is the reason why illuminating engineers have chosen this particular form of projection. Why did they not choose Mercator's, for example?

AUCTOR: The answer to your question is quite definite. It is most important that the projection chosen should be one in which equal areas on the original sphere are represented by equal areas in the projected diagram. In Mercator's projection, areas near the poles are enormously magnified in comparison with areas near the equator. In the sinusoidal diagram, however, equal actual areas are represented by equal paper areas no matter what their shapes or positions. The shapes, it is true, are distorted, but the areas are preserved. It is impossible to preserve *both* shape and area since you cannot cover a sphere with unstretchable material unless you cut it into a *very* large number of *very* small pieces. Since, therefore, it is a case of one or the other, preservation of shape must be sacrificed to preservation of area.

LECTOR: You have stressed this point so much that I feel there must be some important reason for it. Pray enlighten me.

AUCTOR: Most willingly. You remember, no doubt, that the candle-power of a light source and the amount of luminous flux it emits are closely and simply connected. Now imagine a uniform source the candle-power of which is, let us say, I in all directions, and suppose this source to be placed at the centre of a sphere one yard in radius,

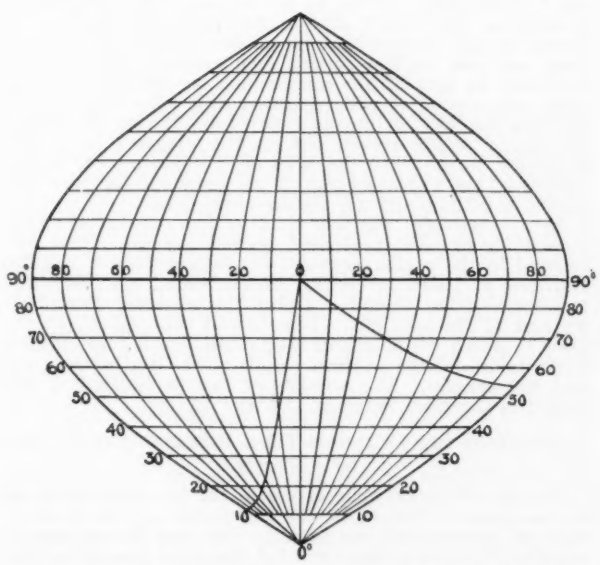


Fig. 4.—The Network of the Iso-Candle Diagram with Kerb Lines.

for instance. The flux reaching the surface of the sphere is then I lumens per square yard. The total flux given by the source is clearly equal to I multiplied by the area of the sphere in square yards—*i.e.*, it is 4 I lumens.*

* There was a young scholar of Rye
Who said, as he breathed a $d\psi$,
The area, I hear,
Of the skin of a sphere
Is r^2 multiplied by 4π.

Of course, if the source is *not* uniform, the flux emitted within any given solid angle may be found by multiplying the *average value* of the candle-power within that solid angle by the area marked out on the sphere surface by the boundaries of the solid angle. In actual practice, if the area is large it is divided into a number of smaller areas so that the average candle-power of the source, as viewed from all parts of any one of these areas on the sphere, can be estimated fairly closely. Then each small area is multiplied by the average candle-power for that area, and the results are added.

Calculating the Flux Emitted.

The use of the iso-candle diagram for the calculation of the flux emitted by a source within a certain solid angular region is now plain. Equal areas on the diagram represent equal areas on the sphere and therefore correspond

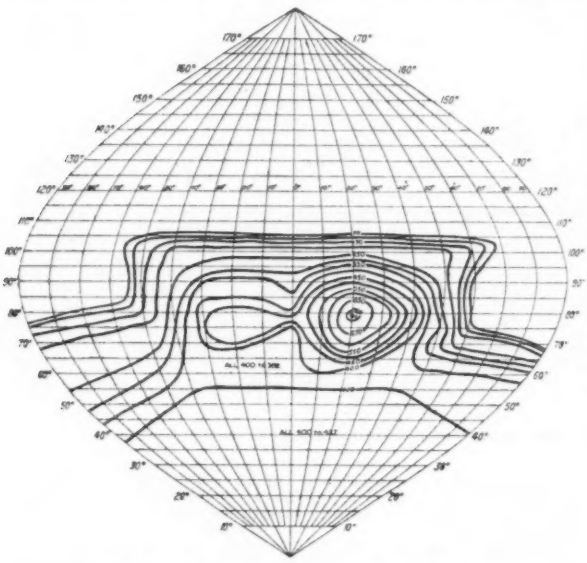


Fig. 5.—The Complete Iso-Candle Diagram.

to equal solid angles. A sphere with a radius equal to one unit of length has an equator which is 2π units long—*i.e.*, the middle line of the diagram drawn to represent one-half of such a sphere *to full scale* is π (*i.e.*, 3·14) units in length. It follows that if an iso-candle diagram be drawn to such a scale that the middle line is, say, 3·14 in. long, an area of one square inch on this diagram will represent an area of one square inch on the sphere of one inch radius—*i.e.*, it will represent unit solid angle. To find the number of lumens emitted by the source within any given region traced out on the diagram it is only necessary to multiply the area of that region (in square inches) by the average value of the candle-power over that region as estimated from the iso-candle lines.

As an example, suppose that in the case of the unit chosen for fig. 5 it is desired to find the amount of flux emitted in the region enclosed (*a*) between the horizontal (latitude 90°) and 10° below the horizontal (lat. 80°) and (*b*) between the direction facing the observer (longitude 0°) and 20° to his right. The area of this region (on the scale to which the length of the middle line is 3·14 units) is 0·030 units and the average candle-power lies between 450 and 500 candles. The number of lumens emitted in this region is therefore between 13·5 and 15.

Calculating the Luminous Flux Reaching the Surface of a Street.

Perhaps the most general use of the iso-candle diagram at the present time is for the calculation of the performance of a street-lighting fitting. The two figures usually required for this purpose are (*a*) the total amount of flux reaching the surface of the street, and (*b*) the illumination produced at a given point of the street, usually the "test-point" defined in the British Standard Specification for Street Lighting.

From what has been stated above it will be clear that, in order to find the total flux reaching the street surface, the first step is to mark on the iso-candle diagram the area which represents the solid angle subtended at the source *by the whole street*. To do this it is convenient to imagine the source mounted in its proper position in the street and surrounded with the glass sphere marked with lines of latitude and longitude. The line of longitude marked 0° is generally assumed to face the observer who is supposed to view the source from a considerable distance down the street.

Now if an imaginary plane be supposed to pass through one kerb of the street and through the source of light (see fig. 6), it will intersect the sphere in a curved line* and the corresponding line on the iso-candle diagram is one of the two required "kerb-lines." The other kerb-line is obtained in an exactly similar way.

Lector: It seems to me that the kerb-line, since it is the intersection of a plane with a sphere, should appear as a straight line on the diagram.

Auctor: It would indeed appear as a straight line on a diagram such as that shown in fig. 2, but do not forget that in the iso-candle diagram there is a certain amount of distortion, and thus it happens that the kerb lines are not straight, except near the centre of the diagram.

The form and position of a kerb line depend on (i) the height of the source and (ii) the distance between the kerb and the point on the road directly beneath the source. Let us call these two lengths h and b respectively. From fig. 6 it will be seen that the kerb-line remains the same for all pairs of values of h and b which give the same angle of slope to the plane passing through the kerb. In other words, it is the ratio b/h which determines the form of the kerb-line; the actual values of b and h separately do not matter. In the Street Lighting Specification an iso-candle diagram is given with the kerb-lines drawn for a range of values of b/h from 0·2 to 3·0.

Let us imagine that the source is mounted at a height of 25 ft. and that it projects 5 ft. outwards from the kerb over the roadway which is, let us say, 40 ft. wide. The two values of b/h are 5/25 and 35/25—*i.e.*, 0·2 and 1·4 respectively, and the corresponding kerb lines are drawn in fig. 4. The area between these lines is the area for which the total flux must be calculated as described above in order to find the total flux reaching the street from the source.

The easiest way of carrying out this calculation is to re-draw these kerb-lines on the appropriate iso-candle diagram and to find the area enclosed between each pair of contours and the kerb-lines.

This has been done for the diagram given in fig. 5, and the results are tabulated below

Pair of Contours (Candles).	Area.*	Pair of Contours (Candles).	Area.*
700–650	0·0045	500–450	0·032
650–600	0·0165	450–400	0·038
600–550	0·023	400–352	0·240
550–500	0·024	400–427	0·685

* The unit chosen is of such a size that the area of the whole diagram is equal to 2π.

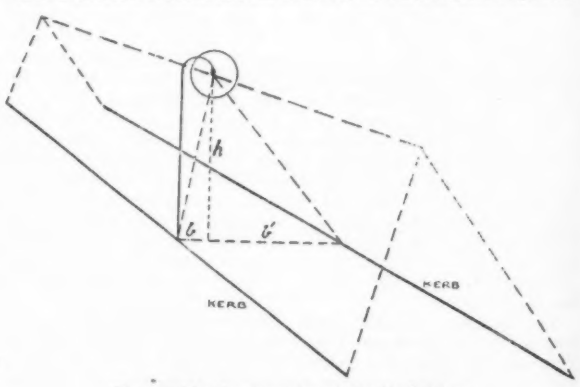


Fig. 6.—The Construction of the Kerb Lines.

The next step is to multiply each area by (*a*) the upper and (*b*) the lower candle-power limit and to sum the results as follows:

Contours.	Area × Higher C.P.	Area × Lower C.P.
700–650	3·1	2·8
650–600	10·7	9·9
600–550	13·8	12·7
550–500	13·2	12·0
500–450	16·0	14·4
450–400	17·1	15·2
400–352	96·0	84·5
400–427	292·0	274·0
	461·9	425·5

* The reader who is accustomed to navigate the high seas will recognize the fact that this line is, in reality, a "great circle" of the sphere, since it is the intersection of the sphere with a plane passing through its centre.

It is laid down in the Street Lighting Specification that, provided these two totals do not differ by more than 20%, their mean may be taken as the true value. Thus the total number of lumens reaching the surface of the street *from one side of the fitting* is 443·7. It is clear that the area of street between each pair of fittings will receive twice this amount of flux—*i.e.*, 887·4 lumens—so that if the fittings are mounted at intervals of 150 ft., the average illumination will be 887·4 ÷ (150 × 40) = 0·15 ft. candle approximately, since 1 lumen per sq. ft. gives an illumination of 1 foot-candle.

Calculating the Test-Point Illumination.

The use of the iso-candle diagram to find the illumination at any specified point P on the roadway is quite a simple and straightforward matter. The first step is to find the candle-power of the source as viewed from P. To do this it is only necessary to find the point on the diagram which represents the point at which the imaginary glass sphere would be intersected by the line joining the source to P.

Probably the simplest method of doing this is a graphical one. If fig. 7 represents a plan of the roadway, P being the point in question and S the position of the source, then the angle of longitude on the diagram is clearly equal to the angle between PS and the line of the kerb—*i.e.*, the angle marked α. To find the angle of latitude a line ST is drawn through S perpendicular to PS and of the correct length to represent the height of the source on the scale of the plan. The required angle of latitude is then the angle STP—*i.e.*, the angle marked β in the diagram.

The candle-power of the source in the direction of P is found by noting the position of the point. (long. α; lat. β) on the iso-candle diagram and reading off the

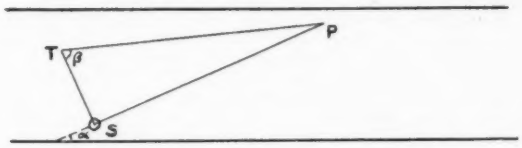


Fig. 7.—The Calculation of Illumination at a Point.

candle-power I at this point. The illumination at P is then given by the familiar formula

$$E = (I/h^2)\cos^3\beta$$

where $\cos\beta = ST/TP$.

As an example, if $\alpha = 23{\cdot}5°$ and $\beta = 71{\cdot}5°$ the candle-power I for the source represented by fig. 5 is 610 and, if $h = 25$ ft.

$$E = (610/625)\,(0{\cdot}317)^3 = 0{\cdot}03 \text{ ft. candle.}$$

The above formula gives, of course, the illumination at P due to the source at S alone. If P receives light from other sources, a similar calculation must be made for each of these and the results must be added to obtain the total illumination.

[Sheets printed with the iso-candle network are now being marketed by Messrs. Wightman Mountain, Ltd., of Artillery House, Victoria Street, S.W. 1.]

A TECHNICAL SIGNPOST : TO THE "JOURNAL" :

Vol. 202, April-June, 1933

General.

Field's Analyses of the accounts of Gas Undertakings for the past year have now been published (p. 907) and their study is most valuable in showing the trend of the Industry in its many branches. In general, there has been a slight decrease in the sales of gas in the various undertakings, the maximum decrease recorded being about 6%. Over the past five years, however, 70% of these undertakings record an increase and 30% a decrease in the gas sold. On analyzing these increased gas sales, it is found that, in general, the increase is due solely to a greater number of consumers, the consumption per consumer having fallen. Prepayment sales and public lighting show, however, a general increase. In the metropolitan and suburban companies, capital charges have increased over the five-yearly period, but in provincial companies and corporation-owned undertakings a reduction in capital has been effected. Despite lower coal prices, the net cost of coal has, with a few exceptions, risen during the above period, the explanation being, of course, the considerably reduced revenue from bye-products. In the case of the suburban companies, however, a slightly lower net coal figure has been realized.

An interesting account (p. 36) has been given of the development of the standardization of gas in Germany over the past ten years. While not selling officially on a thermal basis, greater attention appears to have been given to the relationship between the calorific value and the specific gravity than is generally the case in this country. Present specifications include limits for calorific value of ± 7½ B.Th.U per c.ft., and for specific gravity of ± 0·012. In some cases a combined characteristic is maintained constant—viz., the Wobbe index,

$$\frac{C\,V}{\sqrt{\text{Sp. gr.}}}$$

This index is not, however, a reliable indication of constancy of combustion conditions in any particular burner, and preference is expressed for the so-called Ott Number, this being the setting of the primary air slides of a standard Téclu burner at which oscillation and back firing of the flame cease. In addition, a combination of these two characteristics has been proposed. In regard to the chemical composition of the gas the following limits are given:

Ammonia	0·2%
Oxygen	0·5%
H_2S	*Nil*
$C_{10}H_8$	2·0 grains
Total inerts	12·0%
Sp. gr.	0·5

The use of gas-driven automobiles continues to develop rapidly, despite the obstacle placed by the recent Budget proposal to increase the tax on gas-driven automobiles. In this connection it was resolved at a recent conference of the Municipal Tramways and Transport Association (p. 909) to ask the Government to postpone, for a period of three years, the proposed tax on gas-driven vehicles in order that this project might be allowed unrestricted development. Reports are received of trial 'buses running on gas at Lincoln (p. 37), while a special gas 'bus was in operation at Birmingham for the British Industries Fair (p. 156). This vehicle carried seven cylinders of gas, equivalent to a range of 60 miles, the gas consumption averaging 30-40 c.ft. per mile.

An interesting paper on the application of fuels produced from gas-works products for internal combustion engines has been given by D. E. Bell, the General Manager of the Yorkshire Electrical Tramways (p. 809). In regard to the use of creosote, the most serious disadvantage probably lies in the difficulty of obtaining a consistent and uniform product. The variations in the composition of creosote are notorious, and it is obviously essential that some standard specification be compiled for creosotes supplied for this purpose. In regard to the adaption of petrol engines for this fuel, a not inconsiderable expenditure is entailed in fitting special carburettors, manifolds, &c. For low speeds, petrol is considered preferable owing to the smoky exhaust obtained with creosote. In addition, considerable difficulty is experienced from excessive oil dilution, to overcome which the use of castor oil is proposed. In regard to compressed coal gas, it is suggested that the present exemption of home produced fuels from duty will only be continued so long as sufficient income is obtained from imported fuels. A most interesting table is included showing the relative efficiencies of different fuels for internal combustion engines. Petrol is shown to be the most ex-

pensive fuel, a fact which is solely attributable to the high excise duty imposed on this oil.

Some of the research work which has been in progress during recent years on the analysis of flames is described by Prof. Bone in his recent lecture to the Institution (p. 515). Flame analysis, by which is implied virtually photo-analysis, has been considerably advanced during the past few years by improved photographic technique. The earlier method of photographing on to a rapidly moving film has been replaced by the use of a rapidly rotating mirror and a stationary film. In the latest apparatus, a mirror weighing 8 lbs. rotates in vacuo at a speed of 30,000 r.p.m. The influence of compression waves is also dealt with and in particular the effect of alternatively accelerating and retarding the actual flame waves. In regard to detonation waves, it is pointed out that these are not homogeneous as was formerly supposed, but consist of a comet-like head and luminous tail which rotates at several thousand revolutions per second. The reason for this spin is now being investigated and may possibly be connected with the ionization of the gas, since it may be destroyed by the application of a strong magnetic field.

The use of orifice and venturi meters for the measurement of coal gas is becoming increasingly popular on the Continent, and in a contribution to the "JOURNAL" (p. 918), several of the types now in use are described. When used as recording meters their accuracy is dependent upon a reliable means of recording the differential pressure across the orifice, and the ring balance manometer, which has distinct advantages over the old float type, is being manufactured for this purpose in several forms suitable for industrial use.

CARBONIZATION.

The installation of Koppers ovens at the Beckton Works of the Gas Light and Coke Company has now been in operation for over twelve months, and the working data accumulated over this period have been presented in a paper to the Annual Meeting of the Institution (p. 504). The paper deals mainly with the details of the heating-up and working of the ovens. In the heating-up of the ovens the greatest care was exercised; after consideration of alternative methods it was decided to use producer gas for this purpose coupled with pilot jets of coal gas. The producer gas was burnt in the ovens themselves, which were filled with a core of chequer bricks to distribute the gases and prevent local overheating. Drying was carried out for fourteen days, using only the coal gas pilot jets, after which producer gas was admitted, the volume of gas being strictly controlled and gradually increased. Temperature and expansion measurements were taken daily at a number of points, the temperature measurements being sufficiently extensive to indicate the rate of heating of practically every part of the ovens and flues. The total cost of the heating-up process was slightly over £3000.

The producer gas is generated in mechanical producers, in which is used a mixture of two grades of coke—*i.e.*, 0-$\frac{3}{8}$ in. and $\frac{3}{8}$-$1\frac{1}{2}$ in. in the proportion of 30 to 70—the steam saturation of the blast being adjusted to give a maximum carbon dioxide content of 6% and a gas of about 125 B.Th.U. per c.ft. Under these conditions the average combustible matter in the ash and clinker is found to be about 10%. With the provision of one stand-by producer, it is possible to inspect each unit regularly, a practice which is carried out every 90 days. The dust content of the gas, after scrubbing, is given as 2·5 grains per 100 c.ft. The ovens are charged with a crushed coal (80% under $\frac{1}{8}$ in.) to which a small quantity of water is added by sprays to reduce the difficulty of dust. The throughput of the ovens is given as 20 tons per day, but over 17 tons have been charged and carbonized in 19 hours. Steam jets are inserted in the gas offtake pipes, and these, together with the practice of charging the coal entirely by the central charging opening, eliminates loss of gas during the charging operations. One result of heating by clean producer gas is, of course, that the temperatures can be easily controlled by the setting of the producer gas valves. Despite this advantage, however, the somewhat elaborate system of temperature measurements, which were carried out during the heating-up of the battery, are still continued.

Data have been collected in regard to the setting of producer gas valves, dampers, chimney pull, &c., required for the maintenance of any desired flue temperature and throughput of coal. The carbonizing period has been varied from 20 to 32 hours, the corresponding flue temperatures being 1240° and 1020° C. respectively. The brickwork is specified to stand temperatures of 1400° C., and the present working temperature of 1250° should thus ensure a long life and few repairs. As the ovens taper by $1\frac{3}{8}$ in. from the coke to the machine side the temperature on the latter side is maintained about 70° C. lower than on the coke side. The flue temperatures show, however, a large variation from one oven to another, the example given in the paper showing a difference of ± 100° C. from the mean value. In discussing these figures, it is stated by Dr. E. W. Smith that a maximum variation of 25° C. from one oven to the next is now quite normal coke oven practice. An excellent series of flue gas analyses is quoted, the carbon dioxide varying by only ± 0·5% from the mean value—a figure which not only clearly indicates the uniformity of gas and air feeds, but also the tightness of the brickwork.

Initial difficulties were encountered in maintaining uniform pressure conditions in the gas offtakes from the ovens, due to the "hunting" of the oil-operated automatic control valves, but this difficulty has been overcome, and it is now possible to maintain a steady 2-tenths pressure in the foul gas mains, under which condition the gas contains about 6% of nitrogen. Coke quenching is effected by a quenching tower, in which the rate of water flow is carefully controlled. The coke is subsequently air cooled on a coke bench, and the moisture content of the various grades of coke is as follows:

	%
Over 2	1·9
$2\frac{1}{2}$-$1\frac{1}{2}$	3·6
$1\frac{1}{2}$-$\frac{3}{4}$	6·9

A few details of the yields obtained from 100% gas coal, with two different carbonizing periods, are summarized below:

Carbonizing period, hours	19	..	23·7
Coal, tons per oven per day	16·9	..	17·3
Gas yield, therms per ton	71·87	..	75·62
Calorific value of gas, B.Th.U. per c ft	585·6	..	573·6
Coke and breeze made for sale, cwt	12·43	..	12·20
Fuel consumption, %	12·7	..	13·25

In regard to the characteristics of the gas, a series of analyses is given which shows an appreciable variation in average monthly figures. Thus the calorific value varies from 552 to 587 B.Th.U. per c.ft., the methane content from 29·77% to 33·6%, and unsaturated hydrocarbons from 2·8% to 3·67%. The inert content of the gas varies from 6·78% to 11·52%. During the period comprised by these tests, different types of coal were, of course, carbonized at varying rates of throughput. The method of working with rather high top heats resulted in an unusually high naphthalene content of the crude gas. Difficulties were at first experienced in the coolers, which were initially fitted with tar sprays to remove any naphthalene deposits. With the method of cooling adopted, in which the gas is cooled to about 35° C. in the primary coolers, it was found necessary to circulate gas oil through the coolers to remove the naphthalene. This oil was withdrawn when approaching saturation and utilized in the water gas plant.

With regard to carbonizing yields and costs, a most interesting comparison is made, based on results obtained by the Gas Light and Coke Company from continuous and intermittent vertical retorts, horizontal retorts, and coke ovens respectively. The essential details of this comparison are reproduced below.

Costs per Ton of Coal Carbonized.

—	Continuous Verticals.	Intermittent Verticals.	Coke Ovens.	Horizontal Retorts.
	s. d.	s. d.	s. d.	s. d.
Net coal	7 3·41	7 2·42	7 5·87	8 1·28
Wages	1 1·66	0 10·64	0 8·74	1 4·04
Power	0 0·14	0 0·28	0 1·98	0 0·49
R. and M.	1 1·50	1 1·5	0 7·50	1 2·00
	9 6·71	9 2·84	9 0·09	10 7·81
Capital charges at 8·024%	1 3·98	1 4·82	1 4·28	1 5·27
Total cost per ton	10 10·69	10 7·66	10 4·37	12 1·08
Total cost per therm	0 1.634	0 1·596	0 1·669	0 1·947

The net cost of carbonizing in coke ovens is thus rather higher than in the case of either continuous or intermittent vertical retorts, assuming that in each case the bye-products, tar, coke, &c., have equal value. An increase in the value of coke would, of course, modify the costs in favour of the coke oven, and *vice versa*. It is interesting to note that, so far as the Gas Light and Coke Company's experience is concerned, horizontal retorts are appreciably less economical than any of the three alternative systems.

A further paper on carbonization in coke ovens has been contributed by Evetts (p. 526), in which he describes the installation of coke ovens at the Pont Brulé Works of the Imperial Continental Gas Company. This comprises a battery of 60 S.O.C. ovens and 54 Collin ovens, the respective carbonizing capacities being 1100 and 1250 tons of coal per day. In regard to the advantages of carbonizing in coke ovens a series of calculations is included, showing the maximum variations in gas and coke outputs according to whether the ovens are fired by coal gas or producer gas. Thus in the case of the Collin ovens, a maximum daily gas

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yield of 71,600 therms with a coke yield of 800 tons is possible. Alternatively, the minimum yield of gas is 42,800 therms, the coke being increased to 950 tons. In addition, the carbonizing period may be increased from 16 to 26 hours, giving a further reduction in gas output. The particular advantage of the relative gas and coke flexibility lies in the fact that there is no reduction in coal throughput, and hence the labour charges per ton of coal remain unaltered. Otherwise, by increasing the carbonizing period, the wages rise proportionately. In the case of the Beckton ovens the figures are as follows:

Daily throughput of battery (tons per day)	1200	..	1000	..	850
Tons of coal per man per day	18·2	..	15·9	..	14·9

It is interesting, however, to note that the fuel consumption figures do not appreciably increase—*e.g.*, with 19-hour work the fuel consumption is 12·7% and with 28-hour work the figure is 13·2%. These figures convincingly demonstrate the efficiency of heat recovery and the small loss of heat by radiation and convection from the Beckton installation. Figures are given by Evetts showing that the cost of manufacture is lower in horizontal ovens than in continuous vertical ovens, and, further, that it is also more economical to heat by coal gas than by producer gas.

The installation of C.O.L. ovens at Vancouver, B.C., has now been completed and put into operation (p. 278). The installation comprises 24 chambers, each of a capacity of 4·2 tons per day. The ovens are arranged in four settings of six ovens and are heated by producer gas generated in Lymn-Rambush producers, these being equipped with steam jackets and waste-heat boilers. It is stated that breeze with a high ash content is being gasified. The average gas yield over a period of three months is given as 95 therms per ton, the calorific value being 465 B.Th.U. per c.ft. No other results are published.

A few individual works still adhere to the manufacture of a gas of low calorific value coupled with so-called "complete gasification." Thus at Burnham-on-Sea (p. 268), the gas distributed is a mixture of horizontal gas and a gas from a Moore complete gasification plant, the average yields per ton over twelve months' working being:

Gas	99·2 therms
Calorific value	454 B.Th.U. per c.ft.
Coke	4·2 cwt.
Tar	9·2 galls.

It is unfortunate that the yields from the Moore plant alone could not be ascertained.

Results of experiments in which different proportions of large coke and breeze were gasified in internal producers are given by Tran (p. 559). The tests indicate that the quantity of screened breeze ($\frac{1}{4}$ in. to $\frac{3}{4}$ in.) which could be utilized is limited to about 30%. While no details are given regarding the rate of gasification or the quantity of steam supplied, it would appear that the producers were worked with a fairly large steam supply and at a low rate of gasification.

A new installation of Woodall-Duckham retorts is reported from Oldham, this consisting of 28 of the 103 in. size (p. 332). The new battery of coke ovens at the Irlam Works of the United Steel Corporation has now been put into operation (p. 393). The ovens, which form part of a new centralized steel plant, are of the Becker type, the 51 ovens having an output of about 700 tons of coke per day.

Refractory Materials.

A comprehensive review of the research work which has been carried out by the British Refractories Research Association has been given by Green (p. 339). With regard to the question of standard specifications for various refractories, the relative importance of the different tests, &c., are discussed, and attention is called to the serious difficulty of devising suitable tests and rigid specifications. With the present imperfect knowledge of the properties and structure of these materials considerable latitude must therefore be allowed in many cases. In regard to the work on the various properties of refractories, emphasis is laid on the value of testing the strength and refractoriness of materials under load. Two tests are desirable—viz., at loads of 50 lbs. per sq. in. and 10 lbs. per sq. in. respectively—the following data being noted in each case:

(*a*) Temperature of commencement of subsidence.
(*b*) Temperature of marked acceleration of above.
(*c*) Temperature range of subsidence.
(*d*) Effect of load on temperature-subsidence range.

In summarizing existing knowledge of the thermal properties of refractories, the following generalizations are given:

(*a*) The conductivity of both silica and fireclay refractories increases with the temperature.
(*b*) The conductivity of magnesite decreases with increasing temperature.
(*c*) Silica and fireclay products have similar conductivities, which are increased by a higher initial temperature of firing.

The value of specific heat and diffusivity data is discussed in relation to the heat capacities of furnaces, &c., and particularly with respect to insulating materials. In regard to permeability it is stated that, in the case of vertical retorts, the loss of gas from this source is comparatively small in relation to the total leakage. The study of permeability is particularly important, however, in relation to the slagging effect of dust and various gases, the influence of carbon monoxide on the disintegration of bricks adjacent to "iron spots" being cited as an example.

Difficulties which are experienced with silica products are largely connected with the expansion of this material. Comparative tests with silica bricks made with clay and lime bond respectively fail to indicate the superiority of either product, but clay is regarded as preferable where spalling troubles are likely to occur. The spalling of silica products frequently encountered in vertical retorts is attributed to various factors—viz., local high temperatures after scurfing, impregnation of the material with carbon, structural changes in the silica material itself, due to local temperature variations—all of which tend to promote disintegration and spalling. Observations show that sections of the retort where the temperature fluctuations are at a minimum rarely suffer from spalling, and it is suggested that the temperature changes may ultimately produce a general weakening of the material, with resultant spalling. Of the problem of scurf formation relatively little is known. The variations in the growth and nature of scurf are in general attributable to the type of coal carbonized and the carbonizing temperature.

Coke.

A memorandum has been issued by the Utilization of Coal Committee of the Institution of Mining Engineers on the use of oven coke for domestic purposes (p. 162). During the period 1928-30 the distribution of oven coke was as follows:

	%
Blast furnaces	65
Exported	13
Domestic	16

By 1931, the domestic consumption had risen to 26% and the importance of this market is thus emphasized. The report discusses, *inter alia*, the size of coke suitable for various purposes, reactivity (it being stated that where a coke of low reactivity is in use relatively smaller sizes are preferable), and the influence of moisture and ash. Mention is made of the various types of open grates which have now been adapted for burning coke. In discussing the use of oven coke for domestic purposes, Foxwell emphasizes the distinction between the closed stove and the open fire (p. 276). For the former, the ash should be as finely divided as possible and of the highest fusion point in order to reduce the formation of clinker. For the open fire the reverse is desired, a fine ash forming an unpleasant coating on the surface of the fuel and the surroundings in general. Unfortunately this difference is rarely appreciated—a fact which frequently prejudices the popularity of coke as a domestic fuel.

Purification.

The present position of oxide purification as practised on gas-works is reviewed in an article on p. 922. The shortcomings of the various empirical rules, which have been proposed for determining the area of boxes, volume of oxide, &c., are discussed, and the work of Dunkeley and Leitch, Milbourne, &c., is cited in support of the conclusion that the rate of absorption of hydrogen sulphide decreases as its concentration is increased. The influence of various factors—viz., concentration of hydrogen sulphide, temperature, moisture content of gas and of oxide, and activity of oxide—is considered, and the researches which have been carried out on these aspects are reviewed. No mention, however, is made of the recent work by Clayton and his collaborators, which is of considerable importance in this context. In general, our knowledge of the oxide purification process is essentially empirical, and the few researches which have been carried out up to the present have had little effect on general practice.

An investigation into the cause of the death of large numbers of young fish in the Tees Estuary has led to the conclusion that the trouble is due to the discharge of effluents from adjacent coke oven plants (p. 216). Ample dissolved oxygen was found to be present in the river water and the poisonous effect on the fish was therefore attributed to some specifically toxic constituents of the water. Contamination by coke oven effluents was therefore examined. The effluents were found to be derived from (*a*) ammonia

stills, and (*b*) gas coolers in which the gas is cooled by sprays of water. The presence of tar acids in the still effluents rendered these toxic, a 0·5% solution of the effluent producing fatal effects in a few minutes. The concentration of tar acids in the river water was, however, only 0·01-0·03 part per 100,000, which is well below the danger limit. The cause of the trouble was ultimately traced to the presence of cyanides in the cooler effluents, one part of the effluent per 200 parts of water having fatal results in a few minutes. Cyanides in excess of 0·003 part per 100,000 may be regarded as seriously toxic; and in 283 samples of the river water the cyanide content varied from *nil* to 0·01 part per 100,000. Methods for the removal of the cyanides are discussed—viz.:

(1) Treatment by lime and waste pickle liquor.
(2) Spraying the hot effluent (50° C.) into the air to volatilize the cyanides.

The first method was found to give very satisfactory results, and by the latter method the toxicity was reduced to one-sixteenth of its initial value. Owing to the large volumes of effluent involved it has not been possible so far to apply the methods of treatment to all sources of contamination.

Tar and Benzole.

The production of a standard road tar by the fractional condensation of the tar from the foul gas leaving the retort or oven has been successfully accomplished at the coke oven plant of the Wombwell Main Colliery (p. 811). The tar condensate is allowed to flow in the same direction as the gas, and is removed at a point where the temperature is such as to give the required composition in the condensate. Tar is continuously circulated through the hydraulic main, and it has been found possible to dehydrate crude tar from external sources by adding it to the circulation system. In the above plant, the tar contains a little ammonia, which is removed by washing with wet steam and subsequently drying in a steam-heated drier. Experiments have also been carried out in connection with the Glover-West vertical retorts at the Partington Works of the Manchester Corporation. When using 20% of steam in the retorts, it is found possible to dehydrate 2300 gallons of tar per bed per day, a quantity which represents five times the production of tar per bed of retorts. The temperature of the foul gas leaving the retorts is given in this case as 170° C. A further extension of the process is to utilize the sensible heat of hot producer gas from outside producers (Trefois), which is otherwise wasted. This process has worked successfully during the past ten months, the tar treated being a mixture of 85% vertical and 15% horizontal tar. One producer is capable of dehydrating about 20 tons of this mixture per day.

At the recent International Road Tar Conference, several papers were contributed on the utilization of tar for roads as practised on the Continent (p. 861). Extensive investigations have been carried out in France on the incorporation of coal and other fillers in various grades of tar. Reference is made to the work of the South Metropolitan Gas Company on this subject, the results of which are confirmed by the French investigators. The practical issue of this work is that up to 50% of coal can be efficiently incorporated with tar giving a product not dissimilar to bitumen in its properties. Detailed specifications are given by Mallinson regarding the characteristics of cold tars—*i.e.*, thin fluid tar or tar rendered fluid by easily volatile solvents in order that the product may be directly applied to the road without heating. Results are also given of various tests which may be used to determine the suitability of these tars for road application—viz., flash point, loss in weight due to evaporation of solvent, binding test, consistency of residue after loss of solvent, &c.

Another paper contributed was by Cone on the application of "tar concrete" for road surfacing; in this paper details are given of several large-scale experiments using tar concrete made with different sizes of aggregate. Initial experiments were made with ¼ in. aggregate, mixed with a soft pitch, this being laid on surfaces of tarmacadam, &c., in layers of about 2 in. in thickness. The results were, however, unsatisfactory, the surface cracking and distorting after a certain amount of use. Larger aggregate was then incorporated, mixtures of different aggregates from 1 in. downwards being examined. When laid on a properly constructed surface, the concrete with this larger aggregate gave good results. Details are also given of the method of preparation and application of these "tar concretes."

The results of an investigation into the characteristics required in pitch for briquetting purposes have been published by Hedelmann and Broche (p. 109). The following tests were applied:

(1) Grindability of pitch.
(2) Ductility of pitch at 10 degrees C. above melting point.
(3) Tensile strength of resulting briquettes.

When ground, a suitable pitch should yield 60% below 0·5 mm. and have a ductility value of 60 cm. A pitch possessing these properties coupled with a suitable softening point—viz., 45°-75° C.—should give a satisfactory briquette. By extraction with solvents pitch may be separated into three fractions: (*a*) Insoluble in benzene (free carbon), (*b*) soluble in benzene, and (*c*) soluble in both benzene and petroleum ether. The relative proportions of these fractions may be correlated with the suitability of a pitch for briquetting.

Two new methods of tar treatment have been proposed, one of these, which is specially applicable to low temperature tars, being patented by the South Metropolitan Gas Company (B.P. 387,459) (p. 172). In order to reduce the decomposition of such tars on distillation, the tar is distilled in a pipe still, through the coils of which a mixture of coal gas and tar is circulated. The velocity of the gas tar stream is such that the critical velocity of turbulent flow is exceeded, thereby reducing the peripheral layer of stationary tar. It is stated that the product of velocity multiplied by pipe diameter, divided by the viscosity of the tar, must be between 1000 and 3000. The centrifugal dehydration of tar has received considerable attention in France and is now practised in several works in that country and in Germany. The centrifugal described (p. 912) is comprised of a bowl 27½ in. in diameter, near the top of which is fixed a flat horizontal ring to separate the tar and liquor. The crude tar is fed to the bottom of the bowl and the dehydrated product rises above the ring, while the liquor remains in the lower part of the bowl, from which it is removed. Any sludge in the tar is naturally collected at the periphery of the bowl. For successful dehydration, the tar should be heated to 105°-125° F. and the centrifugal should be rotated at about 2700 r.p.m. Under these conditions the water content may be reduced to 0·5%. The apparatus is finding considerable favour for the partial dehydration of tars for use as holder sealing liquids.

In regard to the possibilities of the production of motor fuels from tar oils by hydrogenation and other means it is of interest to note the remarks of the Chairman of Imperial Chemical Industries, Ltd., at the recent Annual General Meeting (p. 154). In discussing the work of this Company on the hydrogenation of coal, he stated that, while the hydrogenation of tars is not as economical as that of coal, there is a definite field for tar treatment and that development on these lines is envisaged. The high self-ignition temperature of tar oils (creosotes) is frequently cited against their suitability for internal combustion engines, and several investigators have attempted to reduce this temperature by the addition of pro-knock compounds. Thus, according to recent German work (p. 329), promising results are obtained by the addition of amyl nitrite and iron pentacarbonyl—the latter giving the better results.

According to a recent German investigation (p. 329) the formation of gum in benzoles is largely attributable to the catalytic effect of the mercaptans present. Benzole refining without alkali treatment does not remove these compounds, and an alkali wash is therefore regarded as essential. The thickening of creosotes, when used as wash oils for benzole extraction, continues to be a source of difficulty, and in endeavouring to find the reason for this thickening the influence of various gases has been considered (p. 35). At 20° C., oxygen alone produces thickening, similar results being obtained at 100° C. Considerably increased thickening is produced by oxygen in the presence of hydrogen sulphide, the latter being decomposed with the precipitation of sulphur—a reaction which is accelerated by the presence of ferric chloride. It is stated that stable oil-water emulsions only occur when the oil has been appreciably thickened. The presence of tar in the gas (to which thickening is frequently attributed) is considered to be a negligible factor, while it is well known that the addition of naphthalene results in a reduction of the viscosity. Owing to its solvent action on sulphur, circumstances may occur in which it has the effect of indirectly increasing the viscosity. Repeated heating and cooling have little effect below 150° C.; but at temperatures above 180° C. the effect may be serious. A further conclusion, which is contrary to general opinion, is that the presence of tar acids reduces and does not increase the viscosity.

Storage.

A useful paper (p. 284) has been contributed on the design and erection of a 3-million spiral holder at Wolverhampton. Details are given of the calculations involved in the design of the steel tank and also of the special Milbourne truss, by means of which the crown is supported. This latter consists of an upper and lower boom inter-connected by angle iron struts with diagonal bracing. The struts are all vertical and not arranged radially as is customary.

XUM

Calculations are also given regarding the stresses on the guide roller carriages arising from wind and snow, using the formula proposed by Milbourne.

In regard to the waterless holder several improvements are proposed. In place of the truss now used to give rigidity to the disc of waterless holders, it is suggested that the disc be supported by a series of cables (p. 603). These may be brought towards the centre of the holder, or spaced equally round the circumference. In order to facilitate the repair or renewal of the packing at the periphery of the disc in waterless holders, a patented arrangement is proposed by Messrs. Bamag Meguin A.G. (p. 349). This consists briefly of an arrangement whereby access may be had to the disc when lowered to the base of the holder, and takes the form of a covered passage way or opening in the side plates of the holder, this being normally sealed when the holder is at work. Further information has now been published concerning the above Company's new dry holder at Berlin (p. 161). In this holder the gas-tight joint is made by flexible leather rings, through which oil is pumped, some of the oil passing through the porous leather and thereby providing the necessary lubricant. A head of oil of 3 ft. to 5 ft. is maintained, the quantity circulated being about 440 gallons per day. For this purpose a specially prepared mineral oil is used.

Special interest is attached to the erection of a high-pressure holder at Skipton, since this is the first example of this type of holder to be erected in this country (p. 917). The holder, constructed by Messrs. Newton Chambers, has a capacity at normal pressure of 75,000 c.ft., and at the usual storage pressure of 50 lbs. per sq. in. a capacity of 250,000 c.ft.

Lighting and Safety*

By E. M. Severn, South Metropolitan Gas Company.

That considerable improvement in the lighting of the streets of London has been made within the last few years is evident from even a casual inspection of the highways and the by-ways after dark, and this no doubt is equally true of other cities and towns. It is, I think, not mere conceit to suggest that these developments are in some measure attributable to the efforts of the members of this Association.

Revolutionary changes are occurring in all the arts associated with civilization. Possibly, in the not very distant future, outdoor illumination may be achieved by the use of a comparatively few powerful light sources suspended high over our cities and towns. This at present may appear to be as fantastic as some of those ideas of Jules Verne, which, in the fifties, were thought to be the wild dreams of a novelist, but which are to-day common every-day necessities. What is romance to-day may be reality to-morrow.

It is, of course, true that, without the means of illumination which are at our disposal to-day, the present standard of life would be impossible, and we can confidently assert that outdoor illumination has become so important that it now ranks with Transport, Sanitation, Water Supply, and Public Health Services. Although progress at first was slow, public lighting within recent years has contributed adequately to the general advance which has occurred in all civic service. I think this is sufficiently shown by the fact that, whereas in the year 1899 the streets of South London were illuminated with a value equivalent to that afforded by 28,000 candles, in 1932 the figure had increased to approximately 3,453,160 candles; and this is a state of affairs which is probably typical of other cities and towns. So efficiently is gas used for lighting to-day, that this 120-fold increase in the light distributed over the highways of South London has been achieved by an approximate increase of only 10% in the gas used for that purpose.

That the demand for better lighting which became insistent a few years ago was due in part to the phenomenal increase and development of mechanically propelled vehicles, which were capable of speeds unheard of half-a-century earlier, is, of course, true. It is within the memory of some people living to-day that a speed of forty miles an hour, not so long ago, was dangerous, even for an express train, but nowadays thousands of motorists consider this just "cruising" speed. At the recent National Safety Congress, Colonel Pickard remarked that "this is an era of speed and yet higher speed." Truly has it been said that motor cars are increasing by leaps and bounds, and pedestrians are progressing in the same manner. Most of our roads were made before the motor car had arrived. The motor car has taken the roads as it found them, and our problem is how to make the roads reasonably safe for people to use after sunset. I have seen a picture taken from the air after dark of a busy thoroughfare of a great city effectively illuminated by one of the modern systems of artificial illumination which are available to-day, and beneath it the words "Tunnels of light boring through the darkness provide safe channels for fast moving traffic." To provide such tunnels of light should be the object of each member of this Association and of all municipal authorities, and reasonable expenditure should be withheld to achieve this end.

That motorists should be required to contribute to the cost of the effective lighting of the roads is perhaps debatable, but if the high standard of illumination which is nowadays required is due to the use of the roads by motorists, then I suggest it is not wholly unreasonable that they should bear some share of the cost. In this connection the recent comment by Lord Trenchard is not altogether irrelevant. "If pedestrians would realize that the roads nowadays are dangerous places, and would be as careful in crossing them as they are in crossing a railway line, there would be fewer accidents"—a remark which clearly indicates the imperative need for really good lighting on account of dangers from fast-moving traffic.

It is often on those roads which are inadequately illuminated and which connect one busy part of a town with another that motorists frequently "step on the gas and switch on the headlights." In such circumstances the need for increased illumination is directly attributable to the drivers of cars. This aspect of street lighting has been recently emphasized by a well-known authority who has said that "the considerable variation in the standard of lighting which obtained in numerous places throughout the country has been responsible for a large proportion of the accidents which occur after dark, and that until the illumination of the connecting roads is sufficient to render the use of dazzling headlights unnecessary, the risks of accidents will not only remain great but will grow." Prior to the South Metropolitan Gas Company re-lighting with high-power gas lamps a section of roadway which carries the bulk of traffic from the West End of London to the suburbs, a special observation was made at a selected spot on a Saturday night between the hours of 10.30 p.m. and 12.45 a.m., to ascertain the number of motor cars which used their headlights full on. It was noticed that 52 cars used their headlights full on, but on a subsequent evening some six weeks later, after the new scheme of lighting had been put into use, and under similar weather conditions, only nine cars used their headlights.

This prompts me to say a few words concerning the education of public opinion. It is, I believe, sound policy to seek to secure the sympathy and interest of the public in the matter of really good lighting, and it is doubtful if there is any more certain method of achieving this than by practical demonstration of the merits and advantages of up-to-date lighting. The Company with which I am associated followed this course when, three years ago, they demonstrated on a mile of main road the possibilities of a modern system of lighting by high-power gas lamps centrally suspended over the road. The result of the experiment was that a considerable extension of the system was called for, and twenty-six miles of main road in South London are now lit by nearly 1000 lamps (each of 1000 c.p.). This system of lighting has received the unqualified approval of motorists and pedestrians alike.

With the subject of education in mind, I would desire to refer very briefly to the training of the men who will undertake the work of public lighting in the future. The day has passed when the practice of Public Lighting can be carried on by the simple rule-of-thumb methods which sufficed in the past.

We live in an age of specialization, an age which demands the application of science to human needs and requirements. This is especially true of outdoor lighting, which has become one of the most scientific of the arts. This is the day of the expert, and the man who attempts to deal with lighting problems must be equipped with thorough knowledge of the basic principles involved. For this reason your Council proposes to take such steps as are necessary to see that future members of this Association are possessed of the qualifications which are essential to the practice of the art and science of public lighting.

* Extract of Presidential Address delivered before the Association of Public Lighting Engineers, Margate Conference, Sept. 5.

Rational Examination of Coal*

By Wilfrid Francis, M.Sc.Tech., Ph.D., F.I.C.

(*Concluded from p. 461.*)

The author has observed many different compositions of clarains and durains within the following limits:

—	Clarains.	Durains.
	%	%
True ulmins	70–95	30–80
Opaque matter	0– 5	5–50
Plant skins, &c.	2–15	10–20
Resins and hydrocarbons	3– 9	3– 8

Obviously any bright coal without plant remains or opaque matter is a vitrain. A coal containing plant remains but little opaque matter is clarain, and one containing both plant skins and opaque matter in fair proportion is durain. The nearer the coal approaches vitrain in composition the brighter its appearance will be, and the more opaque matter it possesses the duller it will be. Since dull coals contain moderately high proportions of shale as a general rule, intimately mixed with the coal substance, their dull appearance is enhanced. This fact throws light on the origin of durains.

The varying proportions of ingredients present in the various types of coal from any lump or seam are responsible for the differences in properties observed. Thus, coals rich in plant skins burn with a long smoky flame and on distillation give a large yield of oily products with a comparatively small yield of gas, of high calorific value and luminosity. A high proportion of resins or hydrocarbons influences the coal in a similar manner. The presence of opaque matter influences the coal in the opposite direction; coals rich in opaque matter and poor in plant skins burn with little flame and on distillation give a poor oil yield and a gas of low calorific value and luminosity. Durains rich in both plant remains and opaque matter burn at first with a smoky flame until the plant skins have been consumed, and then simply glow, with little flame, until all the coal has been burned.

Determination of Rank.

It has already been stated that the rank of a coal may be defined as the degree of coalification of its ulmin. The degree of coalification of the ulmin may be obtained by measuring some well-defined property. Two properties appear suitable for this purpose: one is the reactivity of the ulmin towards oxidizing agents, the other is ultimate analysis.

For the measurement of the reactivity of coal ulmins towards oxidizing agents, two reagents are used for this purpose—the one is a mixture of hydrochloric acid and potassium chlorate, the other is an alkaline solution of potassium permanganate. These reagents give information of a different type, the former measuring the reactivity of the external groupings of the ulmin molecule, the other measuring the reactivity of both the external groupings and nuclear structure. Both have their uses, advantages, and disadvantages. With the large majority of coals there is a close correlation between the results obtained by the two methods, which is confirmatory evidence that ulmins in all coals form one family of compounds of similar composition, except for a regular variation in the molecular arrangement as one passes from one member of the family to the next member.

The use of ultimate analysis as a measure of rank, or as a basis of classification, is of interest, if only because of its antiquity. Almost a hundred years have passed since Regnault first suggested a commercial classification of coal based upon the amount of oxygen present. This system of classification was followed shortly by a system based upon carbon content (Field, 1849), and later by one based upon the hydrogen content (Rogers, 1858). Since then many investigators have attempted to improve such systems, the most successful effort being due to Seyler, who divides all coals into a number of groups, according to the carbon content of the pure coal substance. Each group he divides into a number of sub-groups according to the hydrogen of the pure coal substance. The carbon content is supposed to group coals according to their rank, and the hydrogen according to their type. In effect, Seyler plots the carbon contents of large numbers of coals against their hydrogen contents, giving names to the coals situated in each group and sub-group. By joining points representing coals of approximately equal calorific value, a series of parallel straight lines are obtained, inclined at an angle to the lines representing coals of equal carbon content or of equal hydrogen content. He says that the combustion characteristics of all coals lying on one of these lines of equal calorific value (called iso-cals) are the same. By combustion characteristics, Seyler means the calorific value, calorific intensity, flame temperature, volume of air required for combustion, and volume of flue gases, &c.

This conclusion is certainly true as a first approximation. The chief objection to this classification is that the chart gives no information regarding the chemical characteristics of coal, which is treated as though it consisted of so many units of carbon, so many units of hydrogen, mixed in any haphazard manner, instead of which these elements are contained in several definite types of compounds, having different properties and occurring in varying proportions.

The difficulty about estimating the rank of coal by ultimate analysis is that it is difficult to isolate pure ulmin from the other coal ingredients and, unless one does so, the determination of rank is only of approximate nature. Rational analysis has shown that the purest form of ulmin occurring naturally in coal is vitrain, which is associated with only a small proportion of resins and hydrocarbons. The carbon content obtained by ultimate analysis of the vitrain in any lump of coal is therefore a good measure of the rank of that coal.

A closer analysis of the ulmin may be obtained from the analysis of vitrain by making a correction for the analysis of the resins and hydrocarbons present. (It is possible to separate these ingredients of coal, by solvent extraction, in a relatively pure form, so that their analyses can be obtained with a fair degree of accuracy. The ulmin, on the contrary, usually suffers oxidation during the separation and tenaciously absorbs the solvents used, with consequent change in analysis.) An example will show the order of magnitude of the above correction. The ash-free-dry analysis of a vitrain, containing 4% of resins, 2% of hydrocarbons, and 94% of ulmin, was found to be, carbon 80·65%, hydrogen 5·4%. Taking the analysis of the resin to be, carbon 80·5%, hydrogen 7·5%, and of the hydrocarbon to be, carbon 88·5%, hydrogen 11·5%, the analysis of the ulmin in this coal is, therefore, carbon 80·5%, hydrogen 5·2%. Even if the analyses of the resin and hydrocarbon used in this calculation are only approximately correct, the analysis calculated for the ulmin will not be far from correct. The carbon content, which may be taken to represent the rank of the ulmin, will be as good a measure of the rank of this coal as can be obtained by ultimate analysis.

The durain from the above coal contained 40% of opaque matter, 39·5% of ulmin, 14% of plant skins, and 6·5% of resins and hydrocarbons. Assuming that there was present twice the amount of resin as hydrocarbon, as in the vitrain, the analysis of the opaque matter may be calculated from the ultimate analysis of the durain, which was, carbon 81·3%, hydrogen 5·1% (analysis of the plant skins was taken as carbon 77%, hydrogen 7·1%). The analysis of the opaque matter, calculated in this manner, is, therefore, carbon 83·3%, hydrogen 3·7%.

Analysis of fusain from the same source was, carbon 89·5%, hydrogen 3·25%, and there was present 32·5% of ulmin. The analysis of the carbonized fibres was, therefore, carbon 94%, hydrogen 2·3%.

The analyses of the chemical ingredients present in the above coal are therefore as follows:

—	Carbon.	Hydrogen.
	%	%
Ulmin	80·5	5·2
Opaque matter	83·3	3·7
Plant skins	77·0	7·1
Resins	80·5	7·5
Hydrocarbons	88·5	11·5
Carbonized fibres	94·0	2·3

It will be seen from these figures that a coal of this rank may have a very variable analysis, depending upon the proportion of ingredients present.

The ultimate analysis of a sample of coal of this rank may be expected to vary from 80·2 to 81·65% of carbon and from 4·8 to 5·65% of hydrogen. Occasional samples of durain may be found containing greater proportions of opaque matter, whose carbon content may reach nearly 82% and whose hydrogen may be as low as 4·5%. Similarly there may exist clarains, with abnormal amounts of

* From a paper before the East Midlands Section of the Institute of Fuel.

plant skins, whose carbon content may be as low as 80%, and hydrogen content may be as high as 5·8%, though limiting compositions may be expected for the majority of coals.

The ultimate analysis of a coal, without reference to its rational analysis, is a very poor guide to either its rank or properties.

Schemes of classification based upon the ultimate analysis of run-of-mine samples of coal are unsatisfactory either as a measure of the properties of coal or as a measure of rank. The following table shows a number of possible types of coal with the same ultimate analysis and rank:

—	Vitrain.	Clarains.			Durains.		
	%	%			%		
Ulmin	94	89·5	85	81·5	71·5	60	49
Resins and hydrocarbons .	6	6	6	6	6	6	6
Plant skins	..	2	4	5	10	15	20
Opaque matter	..	2·5	5	7·5	12·5	19	25

It is apparent that many of the properties of the coals in the above table will be very different. The only properties in common will be those termed by Seyler "Concentration characteristics"—that is, the elementary composition, calorific value, volume of air required for combustion, &c., and the reactivity of the ulmin present. The density, hardness, adsorbtive capacity, type of flame, amount of volatile matter, amount and type of products of distillation, coking properties, inflammability, &c., will all differ.

In addition to the above mixtures, containing ulmin of the same rank, there are many more of the same ultimate analysis and concentration characteristics containing ulmin of different rank. It is possible for the ulmin present in such mixtures to have a carbon content between the limits 80·4% and 81%. If the coal of the above analysis is a vitrain the limits of carbon content of the ulmin present will be only 80·4 to 80·55%. Similarly a coal of analysis, carbon, 80·75, hydrogen, 5·55% could contain ulmin with carbon content varying between 80·5 and 81·4%, while a vitrain of the same analysis, with not more than 9% of mixed resins and hydrocarbons, could only contain ulmin of carbon content 80·5%. Thus the maximum possible error for determination of rank, using the carbon content of the separated vitrain as a guide, is 0·25% for coals containing normal amounts of resins and hydrocarbons. This is less than the inherent error of the ultimate analysis determination for carbon.

The error in determining rank from the ultimate analysis of an average sample of coal may therefore be as great as 1%. One is consequently justified in stating categorically that the rank of a coal is defined accurately by the carbon content of the vitrain present, and that little reliance can be placed upon the determination of rank by ultimate analysis of run-of-mine, or average samples of coal.

We are now in a position to survey the coals of this country in a scientific manner so that the most suitable coal for any industrial purpose may be found. Knowing the influence of rank upon the properties of the ulmins, knowing the properties of the ingredients, and having available methods for measuring the rank of ulmin and the proportions of ingredients present, the mode of application of the rational examination of coal to commercial problems should be clear, especially in its application to the gas making, low-temperature carbonization, and coking industries.

From what has been said in this paper, one is justified in condemning any system of classification or any method of examination of coal that fails to consider the type of coal and nature of the ingredients present. It is lamentable in this period, when the coal industries of the leading nations are languishing for lack of the knowledge to enable better use to be made of their coal resources, that enormous amounts of time, energy, and money are devoted annually to the ultimate and proximate analyses of coal under national auspices, leaving the development of rational methods of examination and classification to individual effort. If a fraction of the money spent on the older methods of analysis were devoted to a survey of coals by rational methods, such as those discussed in this paper, an ideal classification would speedily result and our coal resources could be developed to the utmost advantage.

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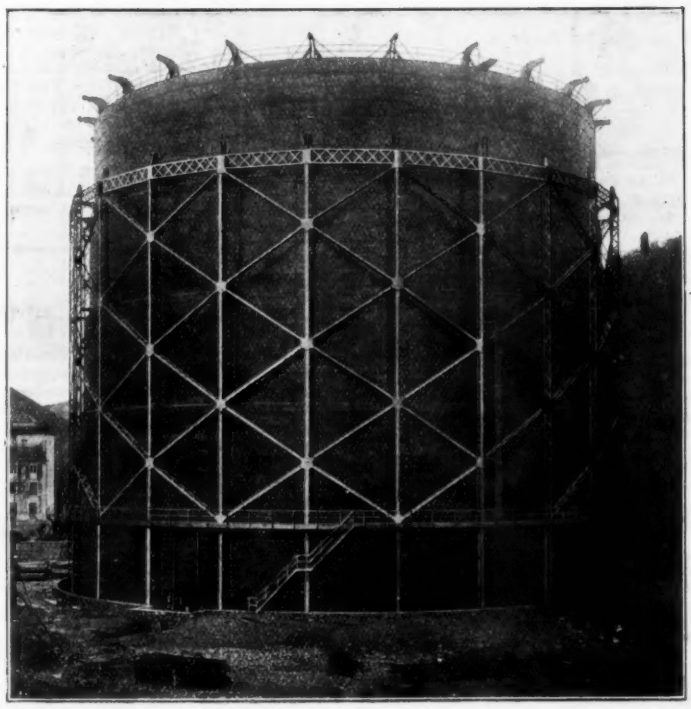

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GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The settlement on Thursday last was a particularly heavy one for the month of August. Profit-taking took place on a large scale towards the close, especially in Home Rails and Mining shares, and prices gave way slightly. A steady demand, however, set in for gilt-edged and other high-class investment securities, while the leading industrials also came into favour.

The Gas Market remained firm and well supported. There is a steady demand for ordinary stocks and shares, and many of these issues showed further substantial improvements. Inquiries for British ordinary took the price up 8 points to 157½, and Plymouth and Stonehouse registered a similar gain at 168½, business being done at 170. European rose 6 points to 140½, which includes the recently announced 2½% interim dividend. Harrogate consolidated and Imperial Continental both gained 5 points to 122½ and 225 respectively, and Gas Light units advanced a further 3d. to 26s. 3d. It will be seen from the Stock and Share List that several other ordinary stocks improved from 1 to 3 points. There were no falls in value other than the usual half-yearly *ex* div. reductions.

At the time of writing there is little ordinary stock available, with the exception of Gas Light units at 27s. and Imperial Continental at 230, but a parcel of £400 Bournemouth 7% maximum is on offer at 167 yielding £4 3s. 9d.%, and £600 East Hull 5% maximum at 110 yielding £4 10s. 10d.%. The maximum dividend on the latter stock has been paid since 1867. As an example of the high prices ruling for ordinary stocks not officially quoted on the Stock Exchange, it is interesting to note that two parcels of the Wellington (Salop) 5% sliding scale stock, on which a dividend of 7% has been paid since 1930, changed hands in London recently at 140.

There is considerably more debenture stock available and the largest amounts on offer include £15,000 South Eastern Gas Corporation 4% 1958-63 at 102½, free of stamp duty (£1 17s. 2d. interest payable March 1 next), giving a flat yield of £3 18s.%; £10,000 Gravesend Gas 5% (perpetual) at 120 *ex* div. yielding £4 3s. 4d.%; and £1000 East Hull 4% (perpetual) at par.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Sept.* 4.

There are no changes to report in the prices of tar products, which are as follows:

Pitch, 80s. per ton f.o.b.

Creosote, 3d. per gallon.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole is firm at 2s. 7d. to 2s. 8d.; pure benzole, 1s. 9d.; solvent naphtha, 95/160, is firm at 1s. 7d. to 1s. 8d.; and 90/140 pyridine bases, 4s. 3d. to 4s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Sept. 4.

The average prices of gas-works products during the week were: Gas-works tar, 30s. to 35s. Pitch—East Coast, 72s. to 75s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 72s. to 75s.* Toluole, naked, North, 1s. 9d. to 1s. 10d. Coal-tar crude naphtha, in bulk, North, 6d. to 6¼d. Solvent naphtha, naked, North, 1s. 5½d. to 1s. 6d. Heavy naphtha, North, 10d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2d. to 2¼d.; low gravity, 2d.; Scotland, 2d. to 2¼d. Heavy oils, in bulk, North, 4d. to 4½d. Carbolic acid, 60's, 2s. 7½d. to 2s. 9d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Sept.* 2.

While pitch remains rather dull, other products are steady with prompt supplies not too plentiful.

Crude gas-works tar.—The actual value is now 40s. to 45s. per ton *ex* works.

Pitch.—Buyers are showing little or no interest at present and price is round 75s. per ton f.o.b. Glasgow. In the home market 75s. per ton *ex* works in bulk continues to be quoted.

Refined tar to Ministry of Transport specification is quiet at 3¼d. per gallon *ex* works in buyers' packages.

Creosote oil is well sold for prompt and forward delivery and values are steady. B.E.S.A. specification is 2¾d. to 3d. per gallon; low gravity, 2½d. to 3d. per gallon; and neutral oil, 2¾d. to 3d. per gallon—all in bulk *ex* works.

Cresylic acid.—While prices are unchanged there is a diminution of stocks. Pale, 97/99%, is 10½d. to 11½d. per gallon; dark, 97/99%, 9d. to 10d. per gallon; and pale, 99/100%, 1s. 2d. to 1s. 3d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha.—Available supplies obtain 4¼d. to 4¾d. per gallon *ex* works in bulk, according to quality and quantity.

Solvent naphtha.—Prompt supplies are scarce and value of 90/160 grade is 1s. 4d. per gallon. 90/190 heavy quality is quoted at 1s. per gallon.

Motor benzole.—Price is nominal at 1s. 5d. per gallon *ex* works.

Pyridines.—90/160 grade is 3s. to 3s. 3d. per gallon, and 90/140 grade 3s. 3d. to 3s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9	to	0 9½	per gallon at works
Motor ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 7½	,,	1 8	,, ,, ,,

Trade Notes.

Gasholder Contract.

Messrs. Clayton, Son, & Co., Ltd., have just received an order for one 500,000 c.ft. capacity waterless gasholder, M.A.N. type, from Messrs. Stewarts & Lloyds, Ltd., for their Corby Works, in respect of which Messrs. H. A. Brassert & Co., Ltd., are acting as Engineers. The holder will be prepared for extension to 1,000,000 c.ft. capacity.

Order for Waterless Gasholder.

The Ruhrgas A.G. have placed a contract for a waterless (M.A.N.) gasholder of 175,000 cub.m. (or rather more than 6 million c.ft.) capacity in connection with their long-distance gas supply.

New Capital Issues.

Bognor Regis Gas and Electricity Company.—As will be seen from our advertisement columns, the Directors of this Company are offering for sale by tender such an amount of additional ordinary consolidated "A" stock as will not exceed, including premiums, the sum of £14,820 0s. 11d., ranking for a standard dividend of 5% subject to the sliding scale.

Gas Companies' Results.

Cleveland.

The Directors of the Cleveland Gas Company present a statement of accounts which shows that the profit made during the half-year to June 30, 1933, has been £447, to which must be added the amount brought forward from last half-year, £4233, making the balance at the credit of the profit and loss account at June 30, 1933, £4681. This sum the Directors propose should be disposed of as follows: In paying a dividend at the rate of 1¼% per annum (less income-tax) for the half-year, and leaving to be carried forward to next half-year's account £4431,

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf-Yr. % p.a.	Dividends. Last Hf-Yr. % p.a.	NAME.	Quotations Sept. 1.	Rise or Fall on Week.	Transactions Lowest and Highest Prices During the Week.
1,551,868	Stk.	Apl. 3	7⅜	7	Alliance & Dublin Ord. ...	120–130	...	...
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	85–95	...	...
557,655	,,	Aug. 28	7	7	Barnet Ord. 7 p.c.	154–159*	–3	...
300,000	1	May 8	1/4⅓	1/9⅓	Bombay, Ltd.	25/–27/–	...	...
178,280	Stk.	Aug. 14	9½	9½	Bournemouth sliding scale	192–202	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	163–168	+3	166–166⅔
439,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	135–140	...	...
50,000	,,	June 26	3	3	Do. 3 p.c. Deb. ...	74–79	...	...
162,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	99–104	...	...
210,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	120–125	...	...
357,900	,,	Aug. 28	7½	7½	Brighton, &c. 6 p.c. Con.' ...	153–158*	...	...
540,000	,,	,,	6⅔	6⅔	Do. 5 p.c. Con. ...	140–145*	–3	144–145
195,500	,,	,,	6	6	Do. 6 p.c. B Pref.	131–136*	–2	...
1,487,500	,,	July 24	5	5	Bristol 5 p.c. max.	111–112a	+½	...
120,420	,,	June 26	4	4	Do. 1st 4 p.c. Deb. ...	99–100a	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	99–100a	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	119–122a	...	...
855,000	,,	Apl. 3	7	8	British Ord.	155–160	+8	...
100,000	,,	June 26	7	7	Do. 7 p.c. Pref.	145–150	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	108–113	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	94–99	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	103–113	...	...
160,000	,,	June 26	5	5	Cambridge 5 p.c. Deb. ...	115–120	...	...
100,000	10	May 22	6	4	Cape Town, Ltd.	7–8	...	...
100,000	10	Apl. 24	4½	4½	Do. 4½ p.c. Pref. ...	7–8	...	...
150,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. ...	92–97	...	95–96
626,860	,,	July 24	6	6	Cardiff Con. Ord.	117–122	...	120–121¾
237,860	,,	June 26	5	5	Do. 5 p.c. Red. Deb.	105–110	...	...
157,150	,,	Aug. 14	6½	5	Chester 5 p.c. Ord.	105–110½	...	...
98,936	1	May 22	2/–	2/–	Colombo, Ltd. Ord.... ...	25/–30/–	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ..	18/6–20/6	...	...
609,204	1	Mar. 20	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	17/6–20/–	...	...
296,053	1	,,	1/3'30	1/3'30	Do. 8 p.c. Pref.	1⅞–1⅝	...	...
1,796,955	Stk.	July 24	6½	5	Commercial Ord.	114–119	...	117–118
475,000	,,	June 12	3	3	Do. 3 p.c. Deb. ...	73–78	...	...
265,272	,,	Mar. 6	—	5	Do. 5 p.c. Deb. ...	120–125	...	...
807,560	,,	Aug. 14	7	7	Croydon sliding scale	143–148	...	...
469,590	,,	,,	5	5	Do. max. div.	101–106	+2	105
500,000	,,	July 10	5	5	Do. 5 p.c. Deb.	120–125	+2	121½
542,270	,,	Mar. 6	7	10	Derby Con.	155–165c	...	...
55,000	,,	July 10	4	4	Do. 4 p.c. Deb.	93–98c	...	...
269,000	,,	Aug. 28	5	5	East Hull Ord. 5 p.c. ...	104–109*	–2	108½
179,500	,,	Aug. 28	6	6	East Surrey Ord. 5 p.c. ...	120–125*	–2	...
155,019	,,	June 26	5	5	Do. 5 p.c. Deb. ...	117–122	...	...
1,002,180	,,	Apl. 3	†5	†7	European, Ltd.	138–143	+6	138–138½
19,373,992	,,	Aug. 14	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	25/9–26/9f	+·/3	26/1½–26/9
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	83–86·	...	84½–85½
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	100–103	...	101½–103
6,102,497	,,	June 12	3	3	Do. 3 p.c. Con. Deb. ...	77–80	...	78½–79½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	115–118	+1	117½–118
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	112–115	...	113½–114½
270,466	,,	Aug. 28	6	6	Harrogate New Cons. ...	120–125*	+5	...
82,500	,,	Aug. 28	7	7	Hastings & St. L. 5 p.c. Conv.	135–140*	–3	...
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	108–113*	–2	...
140,000	1	Apl. 24	†10	†10	Hongkong & China, Ltd. ...	28/–30/–	...	28/10½–29/–
218,200	Stk.	Aug. 14	6	6	Hornsey Con. 3½ p.c. ...	120–125	...	...
5,600,000	,,	May 22	10	14	Imperial Continental Cap.	220–230	+5	220½–225½
223,130	,,	Aug. 14	3½	3½	Do. 3½ p.c. Red. Deb.	89–94	+1	...
235,242	,,	Aug. 14	8½	8½	Lea Bridge 5 p.c. Ord. ...	167–172	...	...
2,145,907	,,	Aug. 14	6	6	Liverpool 5 p.c. Ord. ...	125½–126½b	+1¼	...
245,500	,,	June 26	5	5	Do. 5 p.c. Red. Pref. ...	103–113b	...	...
306,083	,,	July 17	4	4	Do. 4 p.c. Deb. ...	99½–101½b	...	...
165,736	,,	Aug. 28	10	8	Maidstone 5 p.c. Cap. ...	177–189*	–7	...
56,176	,,	July 10	3	3	Do. 3 p.c. Deb. ...	69–74	...	...
75,000	5	June 12	†10	†10	Malta & Mediterranean ...	9–11	...	10⅛–10⅜
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	98–103	...	...
231,978	Stk.	Aug. 28	5	5	M. S. Utility "C." Cons. ...	101–106*	–2	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	91–96*	–2	...
112,126	,,	June 26	4	4	Do. 4 p.c. Deb. ...	100–102	...	101½
148,955	,,	,,	5	5	Do. 5 p.c. Deb. ...	118–118	...	...
675,000	,,	21 May '31	†6	†6	Montevideo, Ltd.	55–65	...	55⅞–55½
2,061,315	,,	Aug. 14	5⅞	5	Newcastle & Gateshead Con.	24/8–25/–d	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	98–100d	+1	...
776,706	,,	July 10	3½	3½	Do. 3½ p.c. Deb. ...	91–93d	...	...
277,285	,,	May 8	5	5	Do. 5 p.c. Deb. '48...	107–109d	...	...
274,000	,,	Aug. 14	5	5	Newport (Mon.) 5 p.c. max.	100–102a	...	...
204,940	,,	Aug. 28	7½	7½	North Middlesex 6 p.c. Con.	144–152*	–1½	...
396,160	,,	Aug. 14	5	5	Northampton 5 p.c. max. ...	101–106	...	...
300,000	,,	Apl. 24	9	7	Oriental, Ltd.	114–119	...	...
816,617	,,	June 26	8	8	Plym'th & Stonehouse 5 p.c.	166–171	+8	167–170
504,416	,,	Aug. 28	8	8	Portsm'th Con. Stk. 4 p.c. Std.	158–168*	–3	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	102–107*	–2	...
114,000	,,	Aug. 14	5	5	Preston 5 p.c. Pref.	101–106	...	...
686,312	,,	July 24	4	4	Primitiva 4 p.c. Rd. Db. 1911	86–91	...	...
389,813	,,	June 26	4	4	Do. 4 p.c. Cons. Deb.	82–87	...	...
150,000	10	Mar. 20	6	6	San Paulo 6 p.c. Pref. ...	6⅞–7⅛	...	...
1,736,968	Stk.	Sept. 5	6	6	Sheffield Cons.	127–130a	...	...
95,000	,,	July 10	4	4	Do. 4 p.c. Deb.	90–94e	...	...
133,201	,,	Feb. 20	8½	5	Shrewsbury 5 p.c. Ord. ...	135–140	...	...
90,000	10	June 12	15	14	South African	3–5	...	...
6,709,895	Stk.	Aug. 14	7	5	South Met. Ord.	125–130	...	128–130
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	134–139	+1	136½–139
850,000	,,	,,	20/–g	4	Do. 4 p.c. Irred. Pf.	98–102	...	...
1,895,445	,,	July 10	3	3	Do. 3 p.c. Deb. ...	76–79	...	79
1 000,000	,,	July 24	5	5	Do. 5 p.c. Red. Deb.	110–114	...	113
209,820	,,	Aug. 14	8½	8½	South Shields Con.	146–148d	...	...
1,543,795	,,	Aug. 14	6	6	South Suburban Ord. 5 p.c.	122–127	...	...
300,000	,,	,,	5	5	Do. 5 p.c. Pref.	111–116	...	...
300,900	,,	,,	—	4	Do. 4 p.c. Pref.	98–102	...	...
868,837	,,	June 26	5	5	Do. 5 p.c. Deb.	118–123	...	...
100,000	,,	,,	—	—	Do. 4 p.c. Deb.	102–105	...	...
647,740	,,	Aug. 28	5	5	Southampt'n Ord. 5 p.c. max.	106–111*	–2	...
121,275	,,	June 26	4	4	Do. 4 p.c. Deb.	99–104	...	...
350,000	,,	Aug. 28	5½	5½	Swansea 5½ p.c. Red. Pref.	107–111*	–2	...
200,000	,,	June 26	6½	6½	Do. 6½ p.c. Red. Deb.	103–108	...	...
1,076,490	,,	Aug. 14	6⅔	6⅔	Tottenham and District Ord.	144–149	+1	146–147½
300,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	121–126	...	124½
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	108–113	...	...
199,005	,,	June 12	4	4	Do. 4 p.c. Deb. ...	96–101	...	...
85,701	,,	Apl. 3	6	6	Tuscan, Ltd., 6 p.c. Red. Db.	80–85	...	...
347,769	,,	Aug. 28	7	7	Uxbridge, &c., 5 p.ct. ...	144–149*	–3	...
88,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	108–113*	–2	...
1,322,220	,,	July 10	7	7	Wandsworth Consolidated	145–150	...	148
1,096,373	,,	,,	5	5	Do. 5 p.c. Pref.	113–118	...	116
1,317,964	,,	June 26	5	5	Do. 5 p.c. Deb.	118–123	...	122
158,400	,,	Aug. 28	6A	5	Winchester W.& G. 5p.c. Con.	107–112*	–2	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g.*—For quarter. *h.*—Paid £3, including 10s. on account of back dividends. *i* The interest due 1/7/33 was paid on that date. * Ex. div. † Paid free of income-tax. ‡ For year. Hongkong & China, Ltd.—paid on £10 shares.

STOCK FOR SALE BY TENDER.

BOGNOR REGIS GAS AND ELECTRICITY COMPANY.

NEW ISSUE OF ORDINARY CAPITAL.

NOTICE is Hereby Given that it is the intention of the Directors of the above Company to OFFER FOR SALE BY TENDER such an amount of ADDITIONAL ORDINARY CONSOLIDATED STOCK "A" as will not exceed, including Premiums, the sum of £14,820 0s. 11d. ranking for a Standard Dividend of Five per cent. per annum subject to the Sliding Scale, equally with the existing similar Stock, which has for the last five and a half years received a dividend of Eight per cent. per annum.

Minimum price of issue, £160 per £100, yielding at that price £5 per cent. per annum.

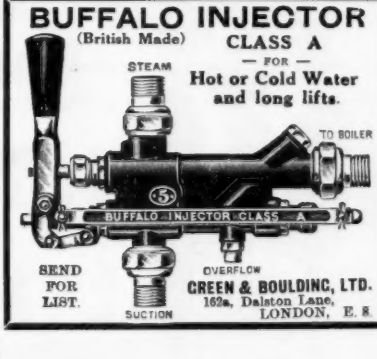
Prospectus and Form of Tender (which latter must be received at the Company's Offices, as under, by noon on Monday, the 18th September, 1933) may be obtained from the undersigned or from the Company's Bankers, WESTMINSTER BANK, LTD., BOGNOR REGIS.

By order of the Board of Directors,
FRANK G. WATSON,
Secretary.

Gas and Electricity Offices,
Argyle Road,
Bognor Regis,
Sept. 2, 1933.

HEMP GRUMMETS
Millions Sold Ask for Samples
A. WITHINSHAW
HELLIER STREET, DUDLEY, WORC.

BUFFALO INJECTOR
(British Made) CLASS A
— FOR —
Hot or Cold Water and long lifts.

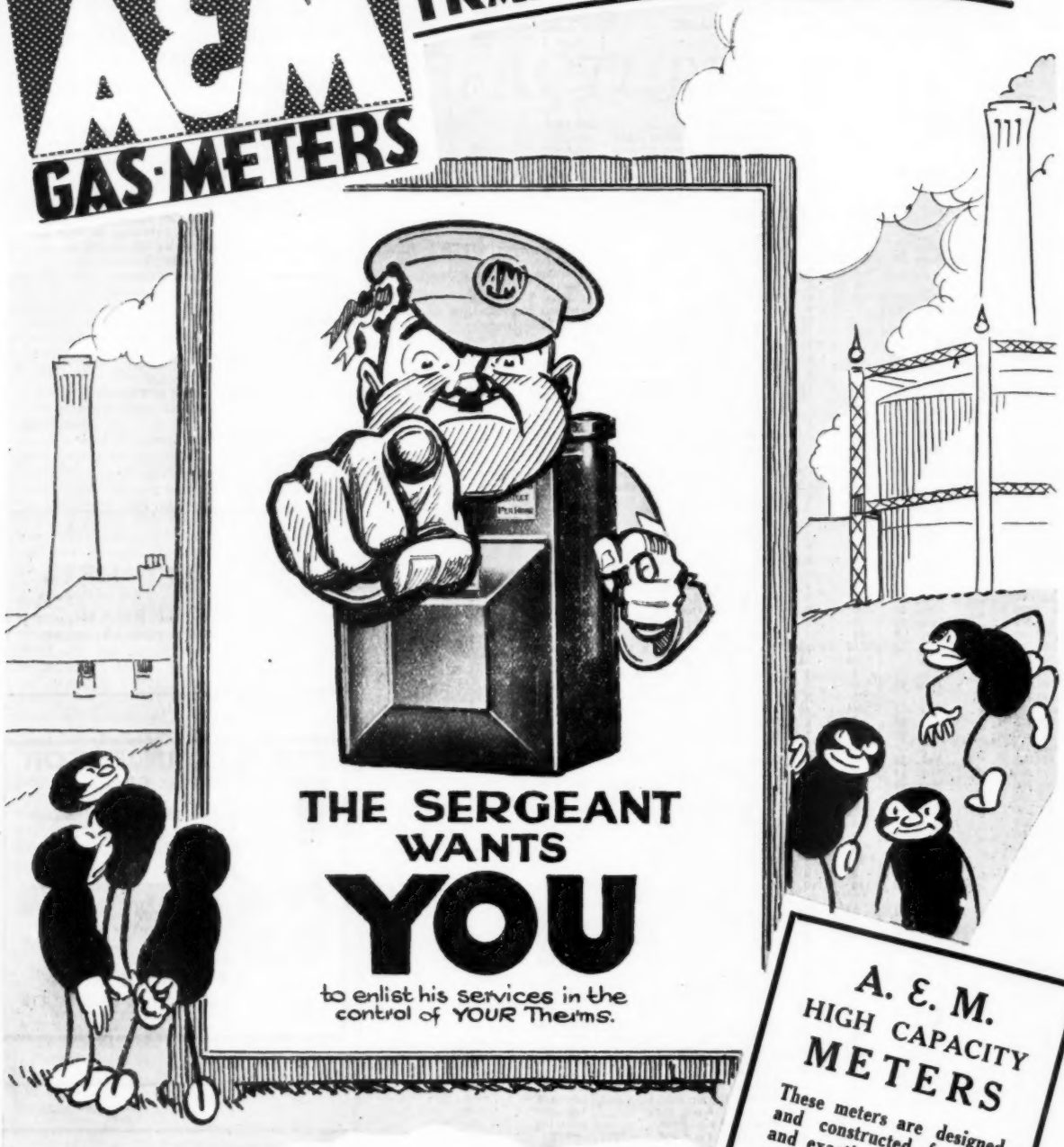


SEND FOR LIST.
GREEN & BOULDING, LTD.
162a, Dalston Lane, LONDON, E. 8.

CAST IRON PIPES
FOR
GAS, WATER, & STEAM
1¼in. to 12in. BORE.
THOS. ALLAN & SONS, LTD.,
Bonlea Foundry,
THORNABY-ON-TEES.
Telegrams: "BONLEA, THORNABY-ON-TEES."
Telephone No.: STOCKTON 66121 (Two lines).

A.E.M GAS-METERS

TRAIN·THE·THERMS



A. E. M.
HIGH CAPACITY
METERS

These meters are designed and constructed for long and exacting service under modern conditions. Pressure losses at capacity are unusually small and registration is precise over a very large range.

The new Dual Coin P.P. mechanism is the acme of simplicity. One operation to the range plate is all that is required to alter from 1d. to 1/- setting, or vice versa.

Ask for a sample of the new 100 cu. ft. Dual Coin P.P.

WILL YOU JOIN?

There is room in the ranks of A.E.M. customers for new recruits. Will you accept service? Sergt. A.E.M. Meters is ready and willing to control your Therms. His initial "E" stands for Efficiency. Join now.

ALDER & MACKAY
LIMITED

MAKE METERS OF METICULOUS MEASUREMENT

ALDER & MACKAY LTD., EDINBURGH, LONDON & BRANCHES.

PUBLISHERS' NOTICE.

TO CORRESPONDENTS: No notice can be taken of anonymous communications, unless authenticated by the name and address of the writer (not necessarily for publication).

TO ADVERTISERS.

NOON ON TUESDAY is the latest hour for receipt of advertisement copy for the following day's issue.

FIRST POST ON MONDAY is the latest for receipt of alterations of standing advertisements.

RATES FOR UNDISPLAYED ADVERTS: Situations Wanted, Six Lines and under (about 36 words), 3s.; each additional Line, 6d. Situations Vacant, Apparatus Wanted and for Sale, Contracts, Public Notices, &c., 9d. per Line—minimum 4s. 6d. An additional charge of 6d. is made where replies are addressed c/o the "JOURNAL."

Full Schedule of Advertising Rates on application.

TERMS OF SUBSCRIPTION.

United Kingdom and Ireland	Advance Rate	35/- per annum. 18/- per half year.
	Credit Rate	40/- per annum. 21/- per half year.
Dominions and Colonies ...		35/- per annum, in advance.
United States (through United States Agent)		$8.50 per annum, in advance.
Other Countries in the Postal Union.		40/- per annum, in advance.

A copy of the "G.J." Calendar and Directory is presented to Continuous Subscribers.

UNITED STATES.—Renewals after December, 1931, and all new subscriptions in the United States, to be made through ROBERT O. LUQUEER, Agent, WOOLWORTH BUILDING, NEW YORK, N.Y.

WALTER KING, LTD., 11, Bolt Court, Fleet Street, London, E.C. 4.
Telephone: Central 2236-7 (2 lines). Telegrams: "GASKING, FLEET LONDON."

FRESH OXIDE

SPENT OXIDE

GAS PURIFICATION & CHEMICAL COMPANY LIMITED,

PALMERSTON HOUSE, 34, OLD BROAD STREET, LONDON, E.C. 2.

(ESTABLISHED 1873.)

Telegrams: "PURIFICATION, STOCK, LONDON."
Telephone: LONDON WALL 9144.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E. 1.

WET AND DRY GAS METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.

REPAIRS RECEIVE PROMPT ATTENTION.

Telephones: Main (Oldham) 3815/6 and 2412 Hop, London.

Telegrams: "BRADDOCK, OLDHAM," and "METRIQUE, LAMB, LONDON."

WEIGHBRIDGES

FOR Motor Lorries and Railway Traffic can be seen erected at our Works READY FOR DELIVERY. Inspection by your Engineer invited and a test by your Local Inspector of Weights and Measures before delivery. Every machine a High-Class Engineering Product and fully guaranteed.

CHARLES ROSS, LIMITED, SHEFFIELD.

OXIDE OF IRON.

SPENT OXIDE BOUGHT.

BALE & CHURCH, LTD., 33, ST. MARY-AT-HILL, LONDON, E.C. 3. Phone: Royal 1484.

"TORTO" FIRE CEMENT.

BALE & CHURCH, LTD., 33, ST. MARY-AT-HILL, LONDON, E.C. 3. Phone: Royal 1484.

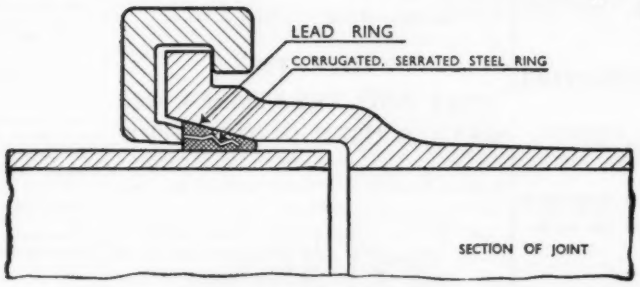
"KLEENOFF," THE COOKER CLEANSER

Tins for Sale to Consumers.
In Bulk for Works Use.
(*See also p. 485 and the "Gas Salesman."*)

BALE & CHURCH, LTD., 33, ST. MARY-AT-HILL, LONDON, E.C. 3. Phone: Royal 1484.

The STANTON Mechanical Lead Joint

(Patent applied for)



NO INCREASED COST

This mechanically made joint works on a similar principle to the Stanton-Wilson Joint, but employs a lead ring in which is encased a thin corrugated, serrated steel ring. It is more flexible than a caulked joint and provides for expansion and contraction of mains—No skilled labour needed.

N.B.—Where a considerable degree of flexibility is required, use the Stanton-Wilson self-adjusting Joint, which has been adopted by over 200 Public Undertakings in this country.

The Stanton Ironworks Company Limited, Near Nottingham

ROBERT DEMPSTER & SONS, Ltd., ELLAND, Builders of CARBONIZING PLANTS, both Horizontal and Vertical. Manufacturers of CONDENSERS, PURIFIERS, GASHOLDERS, &c., also every description of COAL and COKE HANDLING PLANT. Telegrams: "DEMPSTER, ELLAND." Telephone: ELLAND 261 (Private Branch Exchange).

FIRTH BLAKELEY, SONS, & CO., LTD.,
Vulcan Ironworks, Church Fenton, Yorks.,
MANUFACTURERS of Gasholders, Tanks, Condensers, Purifiers, Scrubbers, Washers, and every description of Gas Plant.
Telegrams: "BLAKELEYS, CHURCH FENTON." Telephone: BARKSTON ASH 34 (Private Branch Exchange). Code: "BENTLEYS."

STEAM ENGINES FOR GAS WORKS
ASHWORTH & PARKER,
Riverside Works, Bury, Lancs.
(See illustrated advertisement Aug. 30, p. 436.)

THOMAS DUXBURY AND CO.
16, DEANSGATE, MANCHESTER. PALACE CHAMBERS, WESTMINSTER, S.W.1.
FOR
LUX
GAS PURIFYING MATERIAL.
Immediate delivery from STOCKS at:—
Grangemouth. Middlesbrough, Goole, London, Poole, Newport and Garston.
Quotations given for forward delivery.
SPENT BOUGHT.
Telephones Manchester: Blackfriars 3268 & 3269. London: Whitehall 6501.
Telegrams: Darwinian, Manchester. Darwinian Parl, London.

THE BRITISH GAS PURIFYING MATERIALS CO., LTD.,
99, LONDON ROAD, LEICESTER.
Telegrams: "BRIPURIMAT, LEICESTER." Telephone: LEICESTER 59086.
NATURAL BRITISH PURIFYING MATERIAL
AN ABSOLUTELY STANDARD PRODUCT.
MOISTURE GUARANTEED 28% SUMMER AND WINTER.
"FIRST QUALITY" DUTCH BOG ORE
As supplied to most of the Principal Gas Works in Great Britain.
SPENT OXIDE PURCHASED.

GEORGE WILSON GAS METERS, Ltd.
for
GAS-METERS, ORDINARIES, SLOTS, AND REPAIRS
Foleshill Road, COVENTRY.
'Phone: 8655 Coventry. Grams: "GASMETER."
Certus Works, Kingston Road, Raynes Park, LONDON, S.W.20.
Radium Works, 11, Radium Street, Oldham Road, MANCHESTER.
(See advertisement Aug. 23, p. 373.)

PATENTS.

PATENTS for Inventions, Trade Marks "Advice Handbooks" and Consultations free. KING'S PATENT AGENCY LTD., Director B. T. KING, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Can., 146A, QUEEN VICTORIA ST., E.C. 4, and 57, CHANCERY LANE (near Pat. Off.), LONDON, W.C.2. 47 years' refs. 'Phone Cent. 0682.

MEWBURN, ELLIS, & CO.,
CHARTERED PATENT AGENTS AND TRADE MARK AGENTS,
70 & 72, Chancery Lane, London, W.C.2.
Telegrams: "Patent, London." 'Phone: 243 Holborn.
And 3, St. Nicholas Buildings, Newcastle-on-Tyne.

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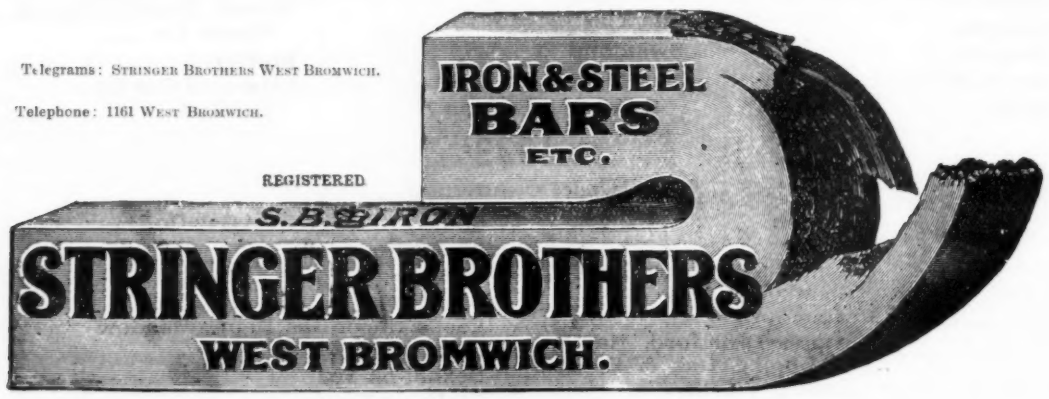

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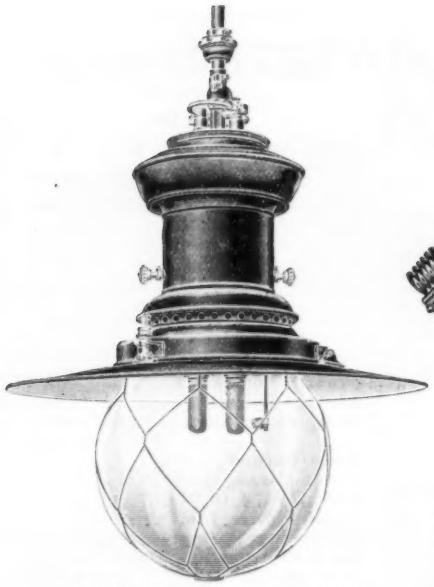

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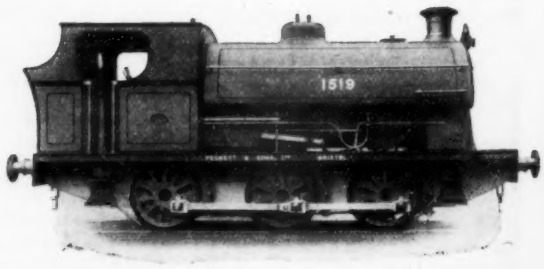

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